INDEXED.

International Marine Engineering

JANUARY, 1912

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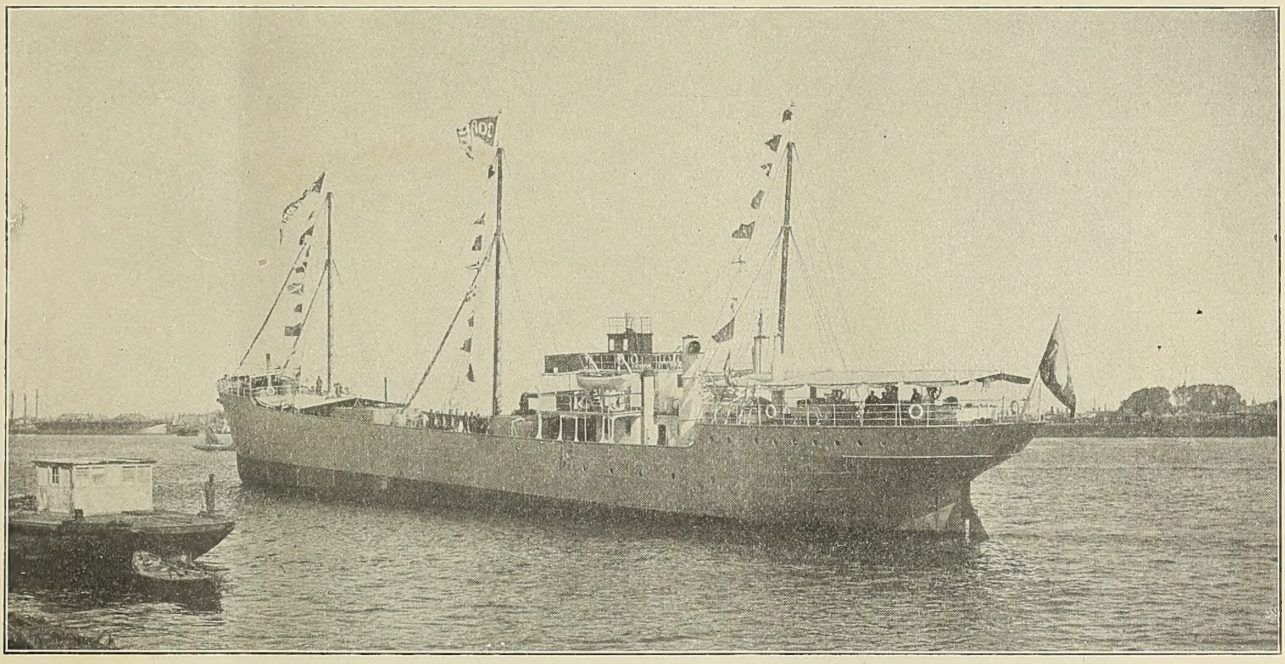
Large Russian Vessels Propelled by Diesel Engines

BY J. RENDELL WILSON

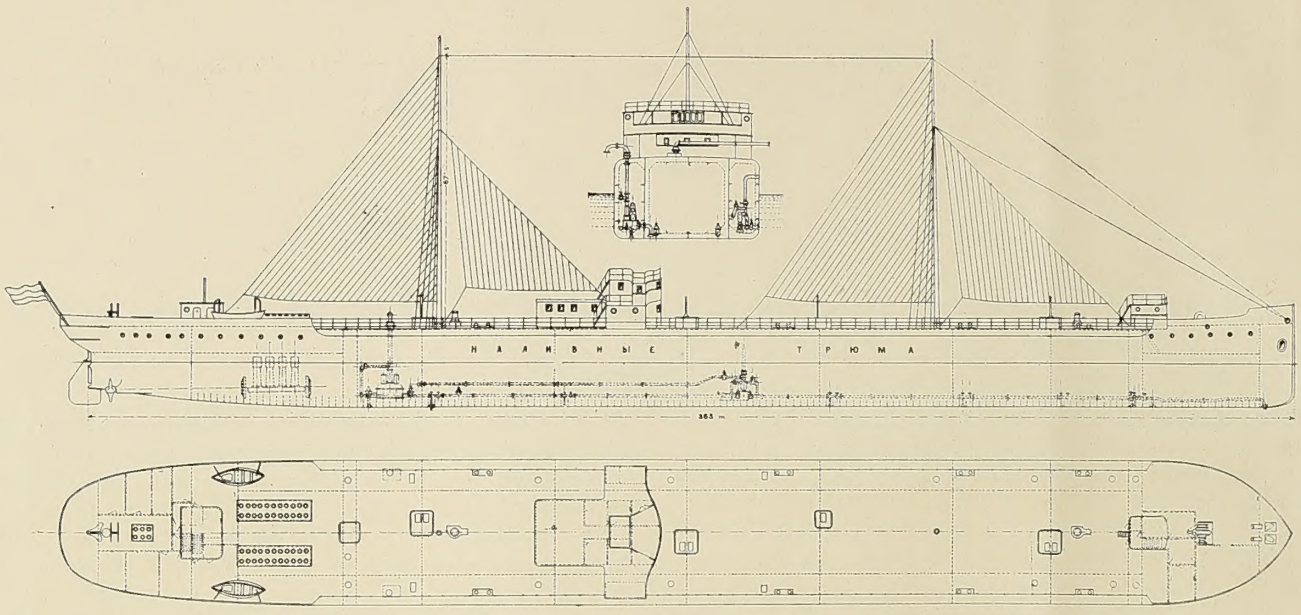
It has been considered by American and British shipbuilders, engineers and owners that Germany and other countries of Western Europe had recently made wonderful strides in the development of the big marine Diesel-type oil engine; and it was conceded by a few, including Lord Furness, that a revolution in the propulsion of shipping was not far distant. But it is almost startling to say now that in Russia this revolution is almost a thing of the past, and large Diesel vessels have been quietly in service since 1903, and at the present time internal-combustion engined ships of 5,000 tons are almost quite common objects. In INTERNATIONAL MARINE ENGINEERING of October I was enabled to give a complete resumé of the progress in Great Britain, Germany, Switzerland, Sweden, Italy, Denmark, France and the Netherlands, and on page 393 I referred to the fact that there were a number of big motor craft in service in Russia, but of reliable data I had very little. However, I am now able to give some very interesting examples of Russia's Diesel fleet. Altogether I have before me details of some forty vessels ranging from 200 tons to 5,000 tons loading capacity fitted with oil engines developing up to 1,200 horsepower per boat.

The development in the Near East is due to the enterprise of such ship owners as the Société Anonyme pour L'Exploitation du Naphte Nobel Frères, of St. Petersburg; Messrs. Merkulew Bros., Messrs. Schmidt, The Lubimov Company, The Kuloaksky Mineral Works, The Caucasus & Mercury Co., and the Ministry of Communication. Credit is also due to the Russian Government, and to the Kolomnaer Maschinenfabrik Actien Gesellschaft, of Kolomna. The latter named have engined no fewer than nineteen Diesel ships, of which five were installed with motors of 1,000 to 1,200 horsepower each, and only two of the nineteen were under 300 horsepower. In addition the Kolomnaer Company are equipping five passenger, mail and cargo vessels with oil engines of 1,200 horsepower per boat, and all will be placed in service in 1911. They are being built to the order of the Caucasus & Mercury Company. The Maschinenfabrik Ludwig Nobel, of St. Petersburg, and the Nicolieff Engineering Company also have, I understand, constructed Diesel engines for naval and cargo vessels.



THE LATEST RUSSIAN DIESEL-ENGINED VESSEL, THE ZORASTER, A 2,000-TON PASSENGER AND CARGO SHIP EQUIPPED WITH TWO 500-HORSE-POWER DIESEL ENGINES

The firm of Nobel Bros., which must not be confused with Ludwig Nobel, placed their first Diesel ship, the *Wandal,* in service in 1903, and now possess a fleet of nineteen big motor craft, and are adding to these very rapidly. *Wandal* was a triple-screw boat of 800 tons loading capacity, 244½ feet long by 31 feet 9 inches beam, with 6 feet draft, and was driven by three triple-cylinder motors, each developing 120 horsepower at 240 revolutions per minute. At that time Diesel engines had not reached the reversing stage, so her triple propellers were driven through del Proposto electrical transmission gear. She has been a very successful vessel, and, I believe, is still running. During recent years new craft have,

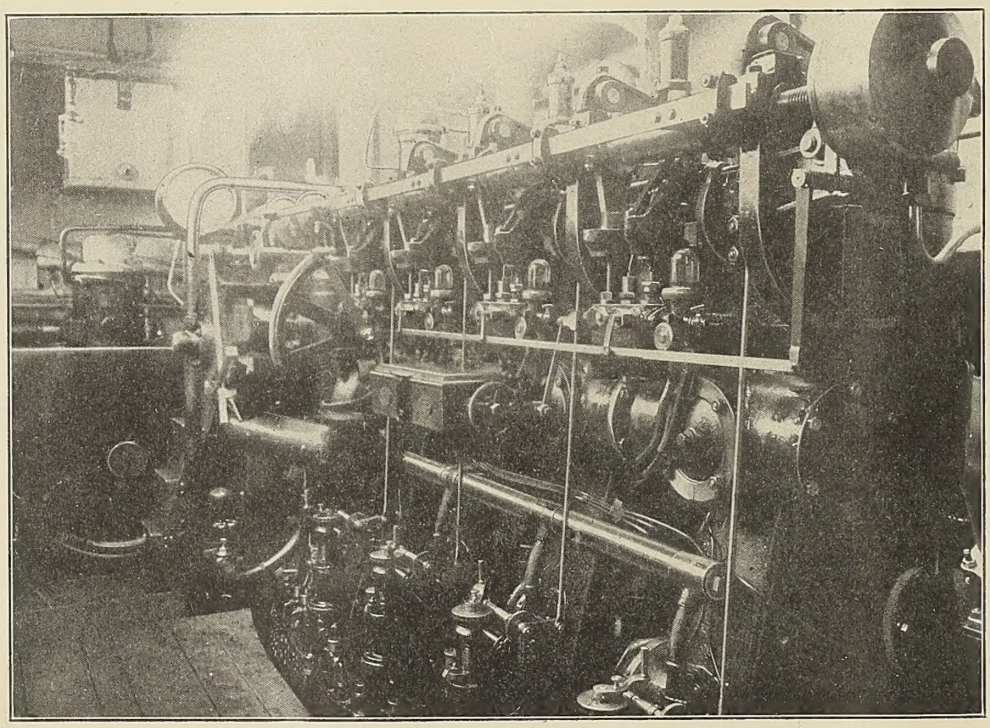


PROFILE AND ACCOMMODATION PLANS OF THE 4,800-TON DIESEL-ENGINED SHIP K. W. HAGELIN

of course, been equipped with reversible engines, so that no clutches or electrical gear is required with the later models.

The illustration of *K. W. Hagelin* depicts one of the largest of Messrs. Nobel Bros. fleet. She is the sister ship to *Emmanuel Nobel,* so the following description corresponds: She is a twin-screw oil tanker, with a loading capacity of over 4,800 tons, and was launched in 1910, a year after *Emmanuel Nobel.* Her propelling machinery consists of two quadruple cylinder Kolomnaer engines, together developing 1,200 horsepower at 150 revolutions per minute, working, of course, on the Diesel principle. She is 380 feet in length by 46 feet beam, with a molded depth of 25 feet and 16 feet 6 inches draft, while her speed is 12 miles. She is engaged in the oil-carrying traffic on the Caspian Sea, and being funnelless has a very striking appearance.

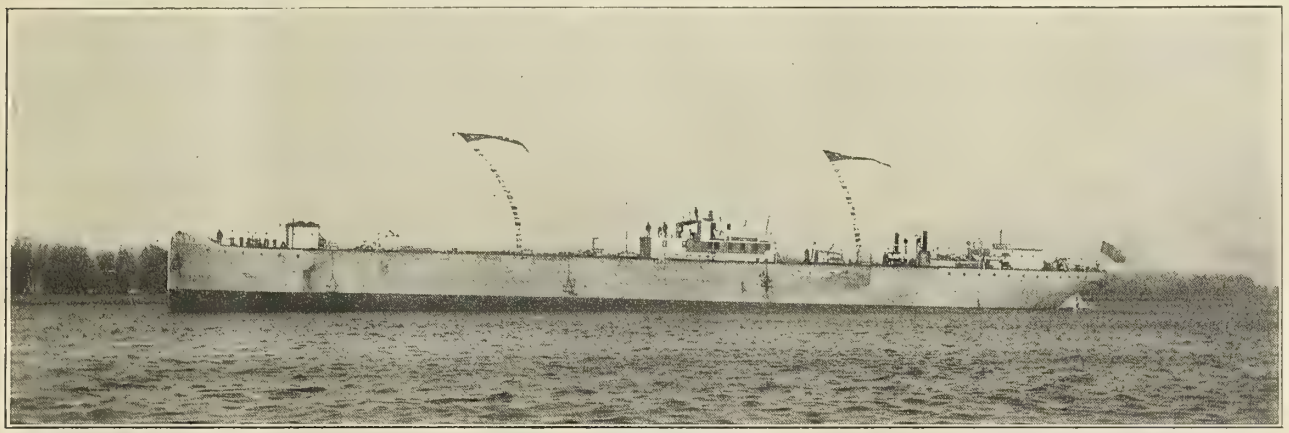
Delo, of which an illustration is also given on the next page, is a tank ship of 4,000 tons loading capacity and 5,300 tons displacement, owned by Messrs. Merkulew Bros., and is in service on the River Volga. She is a twin-screw vessel, fitted with two quadruple-cylinder, 500-horsepower Kolomnaer Diesel engines, developing a total of 1,000 brake-horsepower,



ENGINE ROOM OF TUG AND ICE-BREAKER JAKUT, SHOWING ONE OF THE TWO 160-HORSEPOWER POLAR-DIESEL ENGINES

which give her a speed of a little over 11 miles an hour. The engine-room plan shows that on both the port and starboard side of the main engines there is a three-cylinder oil motor, which drives a compressor off the after end and a pump for emptying the main tanks at the forward end. By adopting this arrangement it is possible for all the starboard (or port) machinery to be broken down without affecting the working of the ship, except to reduce the speed or the rate of filling and emptying the tanks. Each auxiliary engine also drives a

small dynamo for lighting purposes. Reversing is carried out by means of a shaft running parallel with, and on the offside of, each main engine. At the forward end this shaft is driven in the reverse direction by intermediate gearing, and is connected to the propeller shaft by direct gearing. So it will be seen that when the clutch at the after end of the engine is thrown out of connection, the reversing shaft automatically comes into engagement. The drawing shows this clearly.



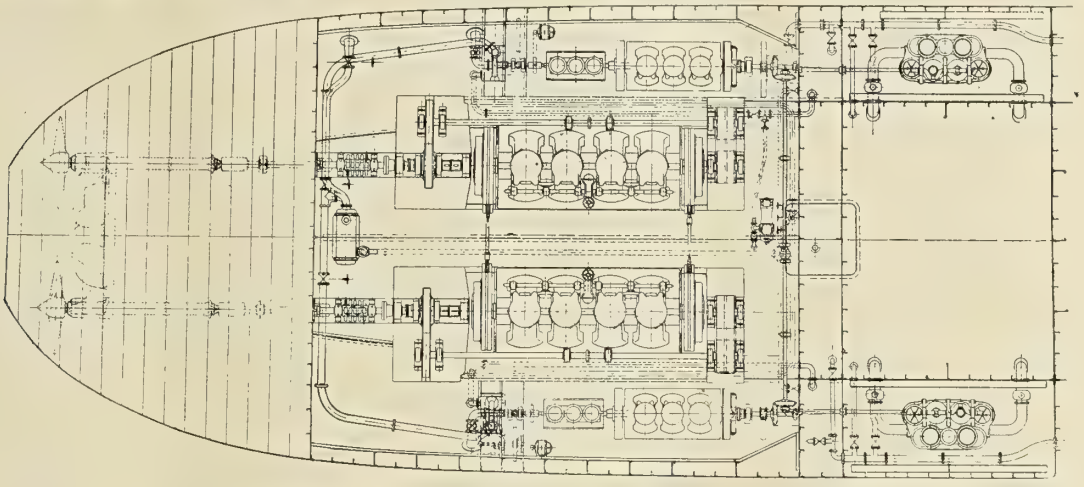
DELO, A 5,300-TON TANK SHIP FITTED WITH TWO 500-HORSEPOWER KOLOMNAER DIESEL ENGINES

It must not be thought that all these Russian Diesel ships are oil-tankers. *Gallilei* and *Zoraster,* two 1,000-horsepower craft of the Nobel fleet, are both passenger and ordinary cargo craft, and are handsome vessels, as commercial craft go. The illustration of *Zoraster* gives a good idea of what these two interesting boats are like. Both were launched in 1911, and are examples of up-to-date power craft. They are 270 feet long by 33 feet 4 inches beam, with 20 feet molded depth and 15 feet 6 inches draft. Each is fitted with two 500 brake-horsepower reversible Diesel engines, running at 200 revolutions per minute. Their net loading capacity is 2,000 tons apiece. Other motor vessels of Messrs. Nobel Bros. fleet are:

Vessel	Tonnage and Capacity	Length	Horsepower	Date
Sarmat	800	244 ft.	360	1904
Belemor	160	110 ft. 6 ins.	140	1908
Kirgis	960	176 ft.	600	1908
Welikoross	1,280	188 ft.	800	1909
Maloross	1,280	188 ft.	800	1909
Jakut	400	105 ft.	320	1909
Samojed	350	132 ft. 9 ins.	280	1909
Robert Nobel	1,760	260 ft.	700	1910
Kalmük	960	190 ft.	600	1910
Ostjak	480	190 ft.	400	1910
Lesgin	480	175 ft.	400	1910
Oestin	480	105 ft.	400	1910
Ingusch	208	140 ft.	200	1910
Masur	200	150 ft.	200	1911

The capacities vary greatly owing to the difference of beam and draft, which lack of space prevents my giving. All of these vessels are fitted with Diesel engines. The question, "Are Diesel ships profitable?" may be answered easily by the fact that the owners of this fleet have, I understand, paid an average dividend during the past five years of 15½ percent on a capital of $11,550,000 (£2,370,000). This capital is now being increased to $23,100,000 (£4,740,000).

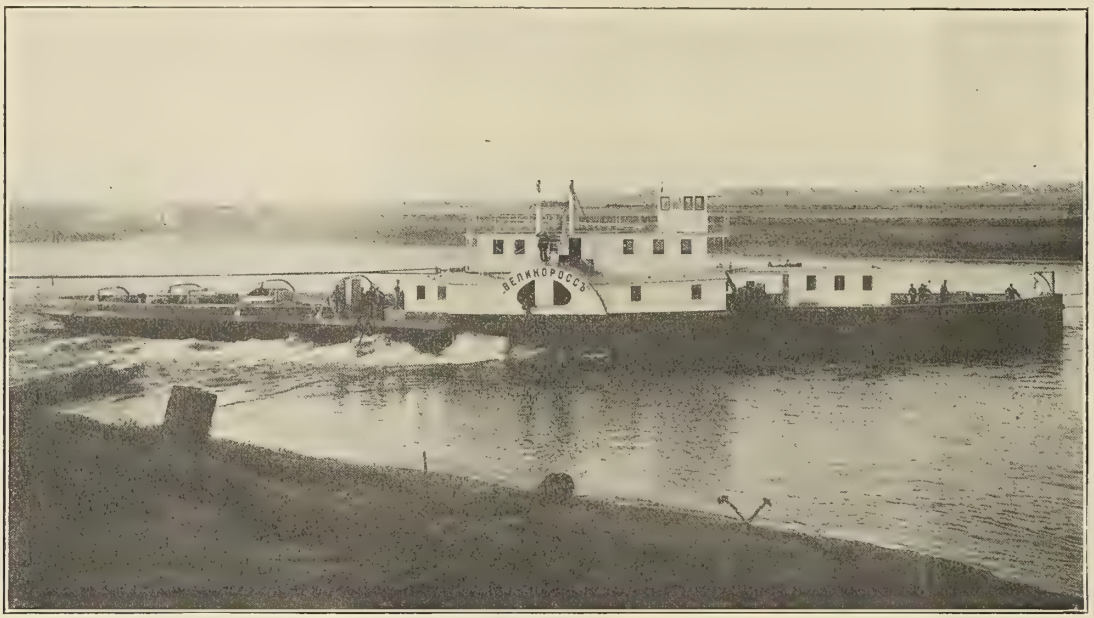
Among the Diesel ships owned by the other firms mentioned are the following: *Myssl,* a 300-horsepower Kolomnaer-engined tug on the Volga; that was placed in service in 1908. *Ilia Mirometz,* a 600-horsepower Kolomnaer-engined tug, also on the Volga, but launched the following year. *No.* 1 and *No.* 2, two passenger boats in service on the Volga, owned by the Ministry of Communication. *Karamish,* a 600-horsepower Kolomnaer-engined cargo vessel on the Volga. *Kolomna A* and *Kolomna B,* two 200-horsepower tugs running on the River Oka. (These two, by the way, are fitted with *horizontal* Kolomnaer marine oil engines.) *Passagirski I.,* an 800-horsepower Kolomnaer-engined cargo and passenger ship, running on the Kama and Volga Rivers.



ENGINE-ROOM ARRANGEMENT OF THE DIESEL-ENGINED SHIP DELO

Curiously enough over a dozen of the craft mentioned in the above two lists are large side paddle-wheelers, which accounts for horizontal engines being fitted in the two cases referred to above. The majority of the paddle-boats are designed as tugs, and on the River Volga they are used chiefly for towing huge tank-barges, some of which have a capacity of over 10,000 tons. To give an idea I may say that one of Messrs. Nobel's barges is 545 feet long over all by 72 feet 4 inches beam, with 11 feet 8 inches draft, and has a loading

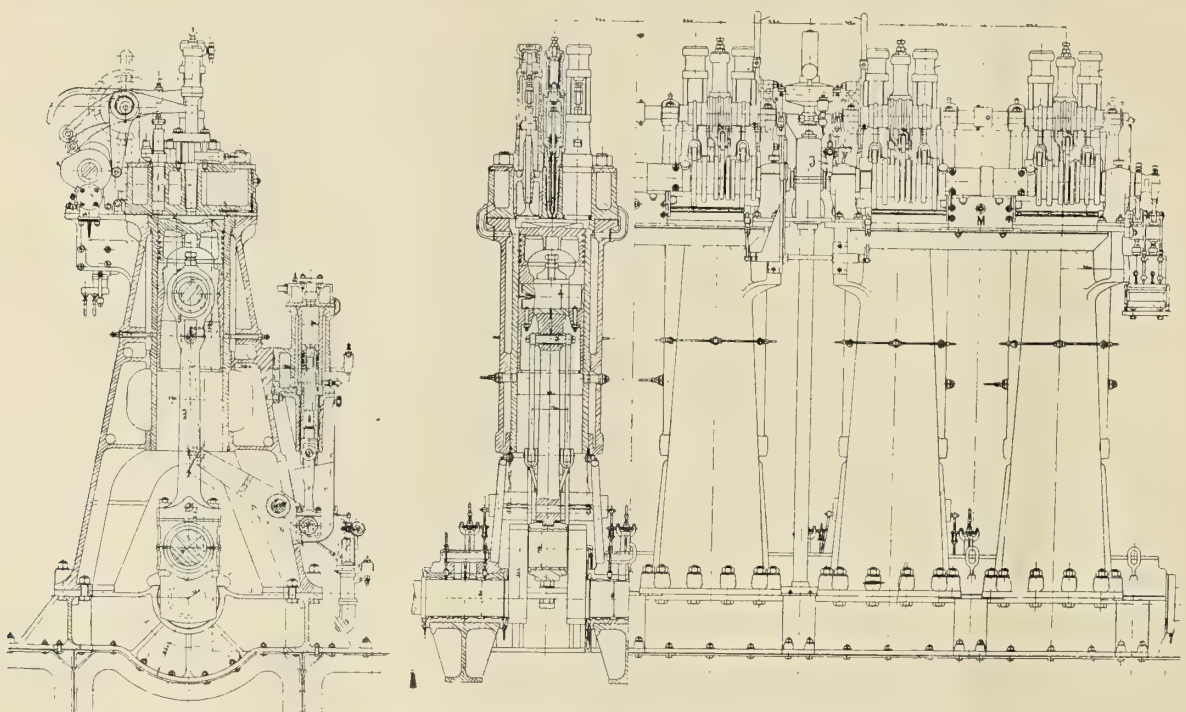
capacity of 10,300 tons. The illustration of *Welikoross* shows clearly the type of motor paddle-boat in vogue. She is 188 feet long by 32 feet 6 inches beam and 3 feet 6 inches draft, and is fitted with two four-cylinder 400-horsepower Kolomnaer engines, turning at 200 revolutions per minute. The machinery is installed athwartships, with the paddle-wheel shaft between the two engines, and the drive is through reduction wheel gearing.



WELIKOROSS, AN 800-HORSEPOWER DIESEL-ENGINED RIVER TUG. MANY VESSELS OF THIS TYPE ARE IN SERVICE ON THE VOLGA

It is often said that naval authorities are slow to adopt new ideas, and only too true of some governments; but this can hardly be said of the Russian Admiralty, as far as heavy oil-consuming internal-combustion engines are concerned. I would respectfully draw the attention of the United States and British naval advisers to the fact that on the Volga and Caspian Sea, Diesel-engined gunboats (powerfully armed and heavily armored) of over 1,000 horsepower have been in service for several years. Those in service on the Volga are of the shallow draft, funnelless type, and are low-lying in appearance with large guns mounted in barbettes. Diesel engines of 1,200 horsepower are fitted.

The gunboats on the Caspian Sea are of a more seaworthy and robust type. At the present time the Société Anon. Chantiers Navals Atelier et Foundiers of Nicolieff are building a Russian revenue cruiser which is being equipped with a Diesel engine of 1,000 horsepower. It is also reported that the Russian Government is building an internal-combustion-engined battleship, which is well on the way to completion. This report, however, cannot be verified.



FOUR-CYLINDER, 400-HORSEPOWER KOLOMNAER MARINE DIESEL ENGINE

Naval Architects and Marine Engineers' Annual Meeting

In the previous issue were published abstracts of the first ten papers read at the nineteenth annual meeting of the American Society of Naval Architects and Marine Engineers recently held in New York. Following are abstracts of the remaining papers read at this meeting:

No. 11—Ship Calculations Derivation and Analysis of Methods

BY NAVAL CONSTRUCTOR T. G. ROBERTS, U. S. N.

ABSTRACT

This paper deals with the first elements of the subject of ship calculations, and might, therefore, seem unnecessary to present before naval architects, but it is expected that the treatment will interest those who may find in these notes a shorter or clearer method of teaching the subject comprehensively to the student. The methods of calculation discussed are those for displacement, center of gravity or curvilinear figure and waterline, center of buoyancy, center of gravity of bottom plating and moment of inertia and metacenter.

No. 12—Economy of the Use of Oil as Fuel for Harbor Vessels

BY ENGINEER-IN-CHIEF C. A. MC ALLISTER

ABSTRACT

Some very valuable data regarding the economy of the use of oil as fuel on board the harbor tug *Golden Gate,* doing revenue cutter boarding duty at San Francisco, Cal., are given in this paper. The data show that the investment paid over 100 percent in annual dividends in this particular instance. The essential details of the apparatus and the results obtained therefrom were published in an article on page 158 of the April, 1911, issue of INTERNATIONAL MARINE ENGINEERING.

No. 13—The Marine Terminal of the Grand Trunk Pacific Railway, Prince Rupert, British Columbia

BY FRANK E. KIRBY AND WILLIAM T. DONNELLY

ABSTRACT

The city of Prince Rupert is located on Kaien Island, which forms the right of the entrance and the southeast shore of Prince Rupert harbor. The city proper is laid out over an area 3½ miles in length by 1 mile in breadth, on the shore of the island, with a background rising to an elevation of from 1,600 to 2,000 feet, the general characteristics reminding one very forcibly of the city of Montreal with Mount Royal behind it. The Grand Trunk Pacific Railway will reach the coast by the Skeena River Valley, about 15 miles to the south, and crossing to Kaien Island at its southern end, will closely follow the shore to and along the water front of Prince Rupert. The general character of the shore of Prince Rupert is bold and rocky, falling off very rapidly to a depth of approximately 20 fathoms. A careful examination of the entire length of the harbor front of Kaien Island determined Hays Cove as the only practical place for such a development as was contemplated; that is, a floating drydock of 20,000 tons lifting capacity, so designed as to be capable of operating in sections as a number of smaller docks, an adequate shore plant comprising electric power generating plant with air compressors, machine shop, boiler and blacksmith shop and covered construction shed under which the pontoons of the floating drydock could be built. The dock is to be of such a design and construction as to be almost entirely built upon the site. To accomplish this the general plan provides for the practical completion and equipment of the shore plant before the drydock is commenced. One of the controlling features in the general plan of this development was the fact that the city of Prince Rupert will be 600 miles from the nearest base of supply or point where any considerable assistance, mechanical or otherwise, can be obtained. It was therefore determined at the outset that the mechanical equipment, large tools, etc., must be of the very best and most complete. Also, that on account of the high price of labor on the Pacific Coast, ample provision for the use of power in every way possible should be made. This has resulted in the design of an electric power generating station with ample capacity for all present needs and with a large possibility of extension.

The first work to be undertaken will be the pier. This will be 420 feet in length and 60 feet in width, the piling being on 10 by 5-foot centers. The pier will require about 600 piles.

At the same time there will be built the platform at the shore end of this pier, 80 feet wide by 930 feet long, having an area of 74,400 square feet, and will require about 1,600 piles on 5 by 10-foot centers. At the western end of this platform there will be an extension off shore 350 feet long by about 100 feet wide, and at right angles to this an extension 560 feet long by 80 feet wide for the attachment of the floating drydock. In front of the main platform, east of the pier, there will be built a launching platform for side launching. This will be 80 feet wide by 440 feet long, and will be carried on 16-inch piles on 5 by 10-foot centers, braced and reinforced by heavy piling along the edge over which the launching will take place.

Electric power is to be furnished for operating the pumping machinery of the floating dry-dock, for compressing air and to operate machinery in the various shops, also for furnishing electric lighting for the plant. The building for the power plant is to contain both boilers and power plant under one roof with fireproof dividing walls, and is to be 104 feet wide by 148 feet long, having a covered area of 15,392 square feet. The building will be of modern steel-frame construction, the walls and roof to be of reinforced concrete. There will be installed six 400-horsepower watertube boilers, supplied with automatic stokers, chain-grate type. Provision is made for adding two extra boilers. There is also a provision for the installation of an economizer, in case it is found that the load factor warrants the expense. Draft will be obtained by a steel or concrete chimney 175 feet high and 11 feet in diameter. An overhead trolley is provided for handling coal from storage to hoppers above the stokers and also for handling ashes. Provision is made for receiving coal both by water and rail. Coal by water will be received at the outer end of the pier, for the unloading of which there is provided a standard grab-bucket installation, so arranged as to load cars beneath the hoppers, the cars to be handled by small yard locomotives to the coal pocket of 1,000 tons capacity, located adjacent to the boiler house. Coal received by rail will be delivered direct from the cars of the Grand Trunk Pacific Railway, which pass at the rear of the property to the coal pocket approached by an incline. There will be two main engines of 900 horsepower each, and while vertical reciprocating compound engines are specified, using steam at 175 pounds pressure and 258 revolutions per minute, turbine engines will be considered as an alternate. Jet condensers are shown, but alternate figures will be taken for surface condensers.

Electric generators are to have a capacity of 600 kilowatts, three-phase, 25-cycle, 550-volt alternating current. For these

generators there will be provided two steam-driven exciters, one of 50 kilowatts and one of 25 kilowatts capacity. These machines are to be direct current, 220 volts. There is also to be a motor-driven exciter of 25 kilowatts capacity, the motor for this machine to be a 35-horsepower, three-phase, 25-cycle, 550-volt alternating-current squirrel-cage-type motor. The entire system of light and power throughout the plant is to be controlled from the switchboard located on the main floor of the power house. There will be provided for the erection of this machinery in the power plant a 15-ton overhead traveling crane. This will be operated by electricity, and the current supplied will be from one of the steam-driven exciter sets. For furnishing compressed air to the shops of the plant there will be provided a compound Corliss air compressor having a displacement of 1,580 cubic feet of free air per minute when operating at 150 revolutions. This compressor is to be designed for a steam pressure of 175 pounds per square inch and for an air pressure of 100 pounds. The distribution of the air will be by means of underground piping through the yard.

The combined boiler and blacksmith shop is to be 76 feet wide by 150 feet long, the central part to be 33 feet wide, provided with a 15-ton traveling crane. The design is of the usual steel-frame shop construction, and will, in this instance, be covered with wood. The flooring will be of concrete with heavy foundations for the large tools. The tool equipment will be very complete, comprising heavy punch and shears, rolls, plate planer, flanging clamps, etc., heavy steam hammer and a full equipment of blacksmiths' tools. The building for the machine shop will be constructed from the same set of plans as the boiler and blacksmith shop. The flooring will be of concrete with special foundations for large tools. Ample provision is made for thorough lighting, and the building will be steam-heated throughout. A very complete equipment of machine tools will be provided, comprising all machinery necessary to handle the heaviest crank and other shafting of large steamers; also boring, drilling and turning machinery for repairing all the secondary machine equipment of steamships. Large tools will be driven by individual motors, the smaller tools being arranged for group driving. A 15-ton overhead traveling crane will be provided for both boiler and machine shop.

On account of the work of building the pontoons for the floating drydock and the possibility of shipbuilding in the future, a building shed and woodworking shop were designed. The shipbuilding portion of the structure is designed to have a covered width of 86 feet by 300 feet long, with a clear height under cranes of 50 feet and under girders of 56 feet. The shop section of this building is to have a width of 80 feet and a length of 300 feet. The ground floor will be used for machinery and the upper floor will be used as a laying-out floor.

There will be an office and administration building, 40 feet wide by 100 feet long, constructed of wood, two and one-half stories high. This will be fitted up with drafting room, accounting and bookkeeping department and private offices.

The 20,000-ton pontoon floating drydock is to be almost entirely constructed at and by the plant of which it is to be the principal feature. This dock is to have an over-all length on keel blocks of 604 feet 4 inches, a clear width of 100 feet and a width over all of 130 feet. The lifting power is the aggregate of twelve pontoons of timber construction, each 130 feet long, corresponding to the width of the dock, 44 feet wide in a direction corresponding to the length of the dock, and 15 feet deep. These pontoons are to be united by steel side walls or wings, 38 feet high, 15 feet wide at the bottom and 10 feet wide at the top, the walls being divided so that the whole structure may be used under ordinary conditions as three separate docks, one of six pontoons, with an over-all length of 269 feet, and two of three pontoons each, with an over-all length of 164 feet each. The largest commercial ship upon the Pacific Coast at the present time is the *Minnesota*. This vessel would have a dead weight in ordinary unloaded condition of approximately 18,000 tons. The machinery for pumping the dock will consist of centrifugal pumps operated by electric motors, the capacity of the equipment being sufficient to pump the entire lifting power of the dock in less than two hours. The structure as a whole is secured to the shore by the engagement of clamps on the dock, with a vertical truss secured to the pile platform or pier in such a way that it is free to rise and fall with the tide, and when being raised or lowered with a ship. The location of these attachments is such that when it is desired to use the dock in three separate sections, the bow section may be detached and moved around the corner of the pier work located as shown on the general plan alongside the platform, and secured in the same manner as provided for in its original position. To make the other two sections available as separate docks, it is only necessary to detach the middle section, comprising six pontoons, from the pier work and advance it the length of the detached section, when the sliding clamps upon the wings will coincide with those used for the previous section when the dock was operated as a whole. This will allow ample space between the center and stern sections for the overhang without interference of vessels which may be docked on them. As the feature of a sectional dock to be used as a whole or separately is somewhat new, it is desired to call attention to the fact that the three largest commercial docks in the United States, namely, the 10,000-ton floating drydock of the Tietjen & Lang Dry Dock Company, built in 1900; the 12,000-ton dock of the Morse Dry Dock Company, built in 1902 (both in New York harbor), and the 10,000-ton dock of the Port of Portland, Portland, Ore., are sectional docks in five sections each. All of these docks are of timber construction and are giving excellent service.

No. 14—Cargo Transference at Steamship Terminals

BY H. MC L. HARDING

ABSTRACT

The purpose of this paper is to indicate the importance of terminals in water transportation, and to show the feasibility of increasing the rapidity of freight movements, of reducing the handling costs, and of increasing the capacity of existing terminals by the adaptation of improved mechanical methods. The figures and data contained in this paper are confined to miscellaneous package freight, excluding bulk freight, and mainly refer to export, import and coastwise traffic. The points covered by the paper are the present movements at terminals of miscellaneous freight, both outbound and inbound, with special reference to the different classes of package freight; the usual methods of handling cargoes to and from ships, lighters, drays and cars; a description of the different kinds of freight transferring machinery, with the details of the mechanism and comparative costs; conditions to be fulfilled by any machinery, and the latest adaptation of different kinds of standard machinery to the freight movements, with a statement of capacity and rapidity of loading and discharging; installation costs of such machinery, including interest and amortization; the cost of operation with maintenance and comparison with manual cost. In summing up the advantages of mechanical methods of package freight movements, of which the most important is the lifting or hoisting, the author comes to the following conclusions: 1. Greater rapidity in lifting, discharging and distributing; the delay of transference can be reduced by one-half in comparison with manual labor. 2. Economy per ton handled; a saving effected of at least one-half. 3. Increased holding or storage capacity at piers. 4. Greater working capacity at each pier. 5. Less port detention, meaning fewer ships to

transport a given tonnage. 6. Saving in port investment. 7. Improved dray service and reduction in damage claims from breakage. 8. A larger return from the money invested in cargo transferring machinery than from any other element of a transportation system. This paper will be published in detail in a future issue of INTERNATIONAL MARINE ENGINEERING.

No. 15—Heavy Oil Engines for Marine Propulsion

BY G. C. DAVISON

ABSTRACT

The Diesel cycle is briefly described and compared with the Otto cycle, and then the relative advantages of four-cycle and two-cycle marine engines are summed up, whereby it is shown that the economy of the four-cycle type results in about 8 or 10 percent less fuel consumption than the two-cycle engine, but with other conditions, such as heat conditions, turning moment, reversibility, weight and space, the advantages lie mainly with the two-cycle engine for marine work. One of the most important parts of the paper is the discussion of mechanical problems connected with heavy oil engines. Here materials, piston speeds, lubrication, piston packing and stuffing-boxes are duly considered. In summing up, the author states that the only problems which have had to be solved are those due to the high-pressure and temperature in the cylinders. From the results thereby obtained it would appear that these practical problems are easily and cheaply solved, whereas it has taken many years of extensive experimental work by manufacturers to investigate and solve these problems. The author shows to what extent oil engines are being used for marine purposes, and the advantages of its use are explained in detail, including economy of fuel, attendance, weight, space, endurance, repairs, reliability, absence of smoke, funnels, cleanliness, readiness for action and time for loading fuel. A proposed installation for a typical high-powered, coal-burning destroyer is also described to show by comparison the advantages of the heavy oil engine.

No. 16—Automatic Record of Propeller Action in an Electrically Propelled Vessel

BY W. L. R. EMMET

ABSTRACT

In studying the problems connected with electric ship propulsion, the author has encountered some contradictions and differences of opinion concerning the conditions necessary for satisfactory reversal. The discussion of these matters and the lack of definite information which has been discovered has led to the making of the experiments which are here recorded, and although the case is not a representative one, the data being definite and certain have some engineering interest as a basis of comparison.

The fireboat *Graeme Stewart* is one of two boats owned by the city of Chicago. (See INTERNATIONAL MARINE ENGINEERING, September, 1908, December, 1908, and January, 1909.) They are equipped with General Electric turbines which drive centrifugal fire pumps. These turbines are also connected to direct-current generators, and each of the twin-screw propellers is driven by a motor. The fields of these motors are separately energized from a constant potential exciting generator, and speed changes are accomplished by changing or reversing the field excitation of the generators.

The automatic record of conditions shown by the curve sheets accompanying the paper was taken by recording ammeters. With this instrument the record of current variations is drawn upon a strip of paper, and arrangements are made by which records of equal time intervals and of propeller revolutions are marked upon the same record. In addition to these records, which are easily provided for, a propeller log was rigged on an outrigger near the bow of the boat and connected through an electric circuit in such a manner that a mark was made upon the record strip every time the propeller made a revolution. The log was calibrated by repeated runs over established distances on the Chicago water front. From the results of this calibration the speed of the vessel through the water can be accurately determined from the marks on the paper down to a speed of about 150 feet per minute.

These automatic records show a rather irregular line for the current record. The current was regulated by the use of the field rheostat of the generator and a dead-beat ammeter in the pilot house, and the average result of the variable currents shown by records is very close to that shown by the curves.

From the records taken directly from these instruments other curves have been made showing the variation of speed to power, slip and average revolutions per minute of the two propellers, and also a curve showing the relation between the torque and the time required to stop the vessel.

In considering the reversal conditions shown by these tests, the propeller characteristics as shown by the slip curve should be borne in mind. The maximum speed which the vessel is capable of making is 11 miles per hour, and at this speed the slip is nearly 19 percent, while at 5 miles per hour it is only 9 percent. This increase of slip at higher speeds indicates that the propeller is of insufficient size, and this deficiency must tend to diminish the value of high torque in reversal.

No. 17—Some Applications of the Principles of Naval Architecture to Aeronautics

BY NAVAL CONSTRUCTOR WILLIAM MC ENTEE, U. S. N.

ABSTRACT

Considering the essential similarity of the problems involved in aeronautics and in naval architecture, it is a singular fact that with the development of the first, both theoretically and experimentally, but little has been done by the trained naval architect. There is no doubt that many difficulties could have been avoided by the earlier experimenters and many practical advantages can be gained to-day by those engaged in aeronautical engineering through the use of some of the fundamental principles of naval architecture. As in naval architecture, the practical elements dealt with in aeronautics are: Weight or displacement, buoyancy, stability, resistance, propulsion and speed. For higher theoretical investigations the mathematics of stream lines or fluid motion are equally applicable to each. At the present time the aeroplane appears to promise greater returns in usefulness, and in any case its development has recently been so rapid that it attracts more interest than does the dirigible. For this reason the discussion in this paper is limited to aeroplanes and deals only with questions of stability and propulsion. The paper will be published in detail in a future issue of INTERNATIONAL MARINE ENGINEERING.

Presentation of the John Fritz Medal

One of the most notable features of the meeting was the presentation of the John Fritz medal to the society's distinguished honorary member, Sir William Henry White, which occurred at the annual banquet which was held in the Grand Ball Room of the Waldorf-Astoria on the evening of Nov. 17. The presentation of the medal was by Mr. Onward Bates, of the John Fritz Medal Board of Award. John Fritz was also present, and responded most fittingly to Sir William's acceptance. The other speakers included Hon. George von L. Meyer, secretary of the United States navy; the president of the society, Mr. Stevenson Taylor, acting as toastmaster.

Marine Gas Engines: Their Design and Application—V

BY E. N. PERCY

(*Continued from page 489, Vol. XVI.*)

If the engine be provided with a governor of the throttle type, at low speeds there will be a weak mixture above the governor and a much denser mixture below the governor for the same reasons. If the governor opens instantly the same action takes place as before, and the engine stops when taking on a heavy load, the engine having speeded up somewhat with the mixture already in the cylinders and pipe, and this robs the pipe above the governor of its rich mixture. During this time the mixture below the governor has been weakened by condensation and wire-drawing through the governor, and this provides the engine with a mixture too weak to run. This mixture seldom backfires, even though weak, because cut off by the governor.

The proper arrangement for overcoming these various objections is as follows: the object being to allow the carburetor to operate under as uniform conditions as possible, no matter what the engine is doing and no matter how quickly the conditions in the engine may be changed, the conditions in the carburetor should change as slowly as possible, the first requirement being a mixture velocity of about 5,000 feet per minute in gas pipe, same to be designed for minimum speed of engine. Above the engine inlet valves should be large chambers, and the branch pipes leading from the manifold pipes to the branch pipes much larger than the manifold pipes if possible. Near each branch pipe or inlet valve should be an auxiliary air pipe. In this pipe is a spring check valve with the spring so adjusted as to allow the valve to open in proportion to the speed of the engine in such a manner as to maintain a mixture velocity of 5,000 feet for minimum speed and a slowly increasing velocity, to no more than 7,000 feet, for maximum speed in order that the mixture pipe may be filled with a somewhat richer mixture for the higher speeds to make up for the purer air taken in through the auxiliary air valve. This system has been found to work perfectly in practice, particularly when used in connection with a positive-action carburetor delivering a definite quantity of fuel for each suction stroke of each cylinder. This arrangement is used substantially as described by one firm, and it has been found that the engine will run at the lowest speeds, or at the highest velocities, with equal ease, and may be instantly changed from one to the other without chocking, missing, back-firing or other symptoms of distress, provided a good carburetor is used.

When the mixture is too rich it is easily noticed in one of several ways, partly by the smoking in exhaust pipe; but as this sometimes also comes from too much lubrication oil it should be carefully regarded, as the lubricating mixture gives a blue smoke and the over-rich mixture gives a heavy black. Also with the over-rich mixture there is a tendency to miss fire, consequently as the exhaust becomes very hot, and if the exhaust opening is near enough to the engine, flame appears with every stroke. The reason for this is that there is so much mixture to burn in insufficient air in the cylinder that it must complete burning in the exhaust pipe. If the mixture is too weak it may be always and positively known by its back-firing into the carburetor, flame frequently issuing from the air valve into the carburetor, the reason being that as a weak mixture is slow burning, and frequently is still burning after the exhaust valve has closed, it ignites the incoming charge, which on account of its plentiful supply of air extends the ignition back to and through the carburetor, a thing which could not occur with the rich mixture on account of the insufficiency of air and of the great cooling action of a rich mixture on the flame.

It should be noted here that gas engines are opposite to liquid-fuel engines or hydrocarbon engines, in this respect, that if a gas engine has too rich a mixture it will back-fire into the exhaust valve, etc., whereas if the mixture becomes too weak it will fire into the exhaust pipe; the reasons of this are that the weak mixture, being plentiful in air, will miss when the two explosions cool in exhaust pipe and then be exploded by the flame of the next explosion, while rich mixture, not being cooled by vaporization as with liquid fuel, and being intimately mixed and extremely inflammable and usually in conjunction with large ports and valves, also being slow burning and frequently still burning after the exhaust valve has closed and the inlet valves open, back-fires with the greatest ease.

In connection with smoke in exhaust pipe it should be noted that when the carburetor is placed too near the engine or in very cold weather, when the fuel does not vaporize but is carried into the engine in a suspended state, the exhaust will smoke because of imperfect combustion. Hence it is important that the carburetor should be placed at a proper distance from the engine, the pipes made of the proper sizes and the auxiliary air valves placed on the engine near the inlet valve if the engine is to be of the variable speed type, or may be placed on or near the carburetor if the engine is of the constant-speed type for turning generators, etc.

It is not possible for any suction jet carburetor to deliver fuel in proportion to the amount of air used, for the reason that as the amount of air used varies so does the rarefication vary in the suction throat, and the laws governing the flow of fluids through an orifice are subject to a large variation. Friction, as in a needle valve, does not vary in the same proportion as the laws which govern the rarefication of a given amount of gas passing through a constricted orifice. This may be easily investigated and proved with complicated formulæ by those who care to take the trouble.

The ideal carburetor will measure a definite quantity of fuel for each stroke of the engine; this quantity to be varied by definite action by the governor, only such minute quantities of fluid are extremely hard to measure accurately, and it is doubtful if it can be done at all in single strokes, but by having the carburetor deliver sufficient for three or four piston displacements, or even more, and then having this measured amount passed through a spray nozzle, perhaps practical results may be reached.

Carburetors for alcohol, kerosene (paraffin) and heavy distillates require jacketing, because these fuels are not vaporized at atmospheric temperatures. With alcohol it should be remembered that shellaced cork floats cannot be used, as the alcohol destroys the shellac and disintegrates the cork.

The temperature of hot jackets must be carefully adjusted for the fuel, because if too hot the carbon residue is left, and if too cold only the lighter and more volatile parts of the fuel are used. With alcohol it is sufficient to have the carburetor at the heat of boiling water; in other words, the carburetor may be jacketed with heated water from the engine jacket. Alcohol may even be used in an ordinary carburetor, provided the carburetor be first started by gasoline (petrol), but in this case the alcohol has not been carbureted but is merely in suspension in the air. To make the best use of alcohol the inlet pipes, valves and carburetor should be jacketed with hot water.

In the case of kerosene (paraffin) it is necessary to have a

very much hotter carburetor. This does not mean a red-hot plate or retort which involves actual chemical changes, but a carburetor and inlet pipes which are jacketed with hot gas from the exhaust and which have been found to give very good results, otherwise it is entirely a matter of adjustment, as with any other carburetor.

With the heavy distillates it is better to merely jacket the carburetor and use highly-heated air for carburetion. The reason is that if the distillates be heated by anything much over 400 or 500 degrees F. they split up and deposit carbons and tars, whereas kerosene does not exhibit such tendencies.

The temperature of air used for carburetion is an important matter; if atmospheric air be used with any of the fuels in question it may frequently be noticed that the carburetors and inlet pipes are covered with frost or dew. In such a case there is very apt to be imperfect carburetion, because the temperature is so reduced by vaporization that the remainder of the fuel is carried in suspension or condensed on the sides of the inlet pipe. In practical tests it has been found that the engine is very apt to smoke on account of unburnt fuel, even though the mixture be comparatively weak, when the carburetor is running very cool, and for this reason it is very usual to supply the carburetor with heated air.

According to the condition, fuel used, etc., it is usual to heat this air to all degrees varying from merely warm air, taken from the vicinity of the engine, to highly heated air, taken from the lower part of the cylinders or a special exhaust heater, depending largely on the fuel used and the temperature obtained. The best results seem to be obtained when the temperature of the incoming air is such that the carburetor and pipes do not collect frost and very little dew or outside condensation.

Many methods have been provided for starting carburetors with fuel requiring greater temperature than the atmosphere for vaporization, some having torches, some special attachments; but the most general and practical method is to operate the engine with gasoline (petrol), either from the same carburetor or from another carburetor, until everything is warmed up. This method causes loss, but nevertheless involves less risk than any other in present use.

The injection of water by means of a water carburetor in connection with the heavy distillates is a very necessary factor. This action is not fully understood and can only be speculated upon. But it is known that heavier distillates may be burned in connection with it; that the engines run cleaner; that higher compression may be employed on account of its cooling action, and that the engines in general run a little cooler.

For the heaviest distillates and crude oil, there have been many inventions made which intended to utilize same in gas engines. All of them, so far as is known (and some thousands of patents have been taken out), may be reduced to one principle: a retort externally heated, usually by the exhaust heat of the engine; a place to put the oil in, another place to take the gas out and the usual means for removing the residue.

The principal feature which militates against their success is fractional distillation; that is to say, instead of making a permanent gas they have distilled the vapors at various temperatures, which makes a condensible vapor, and its products do not only include lighter hydrocarbon but also heavy tars, gums, etc., which vaporize in distilling at low temperatures and play havoc with the engine. As these products are entirely distillates or vapors and not permanent gases, any attempt to wash or scrub them would leave little, if anything, for the engine, and the quantity of residue in the retort is so great as to render it mechanically inefficient in a short time. All the vaporous retorts are either unmechanical or all those which work well mechanically fail in the following important respects:

In the first place, the oil should be filtered in order to remove foreign substances and the heavier clotted hydrocarbon, so that they will not enter the retort at all. Next the oil, before being treated by any other process, should be cracked; that is to say, it should be vaporized, the vapors condensed against a cold cover and allowed to drop back into the oil bed, which process reduces the oil to a fine consistency and a more simple series of hydrocarbons. By referring to a previous statement it will be noted that temperatures of 1,000 degrees to 2,000 degrees are necessary to effect chemical combinations of the various hydrocarbon series and make stable gases.

In calculating the latent heat of oil, together with the temperature, the amount of heat necessary to effect chemical combination in making stable gases, it may be generally accepted that the exhaust heat of the engine is entirely inadequate to make stable gases from any kind of oil. Therefore there should be another source of heat, possibly the oil flame, the heat of the exhaust being used merely for preliminary purposes, possibly the cracking of the oil. Furthermore, as it is probable in any event that there will be residue and tar, perhaps both could be burned externally and furnish this source of heat. On account of the large proportion of carbon in these series there is an obvious necessity of additional oxygen and hydrogen to assist in the making of any stable gas. This may be supplied by the addition of steam or water in some part of the process.

Such processes have often been successful in the actual making of a stable gas, as, for instance, directing an oil spray against white-hot material in conjunction with steam; the leading of lighter vapors and steam into a white-hot retort, or retort heated to 600 degrees C. externally. So much lampblack and other by-products are ejected as to render the process too expensive for gas engines in a general way, although it is used at present in a number of instances for want of a better method. This class of work, however, is not to be treated with carburetors and belongs more properly to gas producers, and is taken up in that chapter.

Cylinders, Heads, Valves and Pistons

Material—Nothing about the gas engine involves such careful design and workmanship as the cylinder and its auxiliaries, because of the great pressures, high temperatures, sudden shocks, unequal expansion and wide differences in temperature of the parts. Therefore the designer is called upon to meet many most difficult conditions. Because of these same things mechanical work is rendered much more complicated. Instead of making parts to merely fit each other, actual allowances must be made for differences in temperature, and careful consideration must be given to the condition of each mechanical part under operative conditions.

Cast iron is the most widely used material for gas-engine cylinders, most cylinders being cast integral with jacket. Some of the engines made of this material include extremely high-speed engines of light construction for automobiles, motor boats and air ships, having cylinders constructed of special alloys, containing percentages of aluminum, nickel and other constituents. Cylinders have also been made with simple steel tops, bushed with cast iron.

In very large engines cast steel is frequently used, the main object being to get the greatest strength for the least possible design, but owing to the great factor of expansion of steel with varying temperatures, great care should be exercised in the use of same.

Design—There is much discussion as to whether the heads should be cast integral with the cylinders or separately and bolted on. It is advisable largely to make the engine with the heads cast integral, and it is perfectly admissible if small enough so that the cylinder may be removed easily. But even this is risky, as frequently the cylinder is not replaced exactly in line. It is probable that small engines are better off

with heads cast integral, and large engines, say cylinders more than 5 inches in diameter, should have separate heads.

Certain points should be observed to make separate heads successful in every way. First, gasket should be used and no water should pass through gasket, all water connections being made by outside fittings. Ground joints are used with great success, provided the head is never removed except by skilled workmanship, but such a head requires valves mounted in cages for removable ignitors and piston removable through the lower end of the cylinder, so that the head need be removed very seldom, if ever. Hence the ground joint may be assumed as satisfactory in the hands of highly skilled workmen and not suitable for mercantile engines, which are liable to be repaired by workmen of moderate skill and put together in an unclean condition.

Owing to the high-pressures and temperatures and small density of the gases, especially in the case of long-stroke, slow-running engines, serious losses may be experienced by leakage through the hot joints. A very successful method of overcoming this is to extend the head a considerable distance down on the cylinder; in fact, practically dividing the cylinder into two halves, one-half of which forms the head, thereby removing the joint from the point of pressure to a point just level to the top of the piston at the end of the stroke. In this case neither gasket nor ground joint is needed, merely a good mechanical joint.

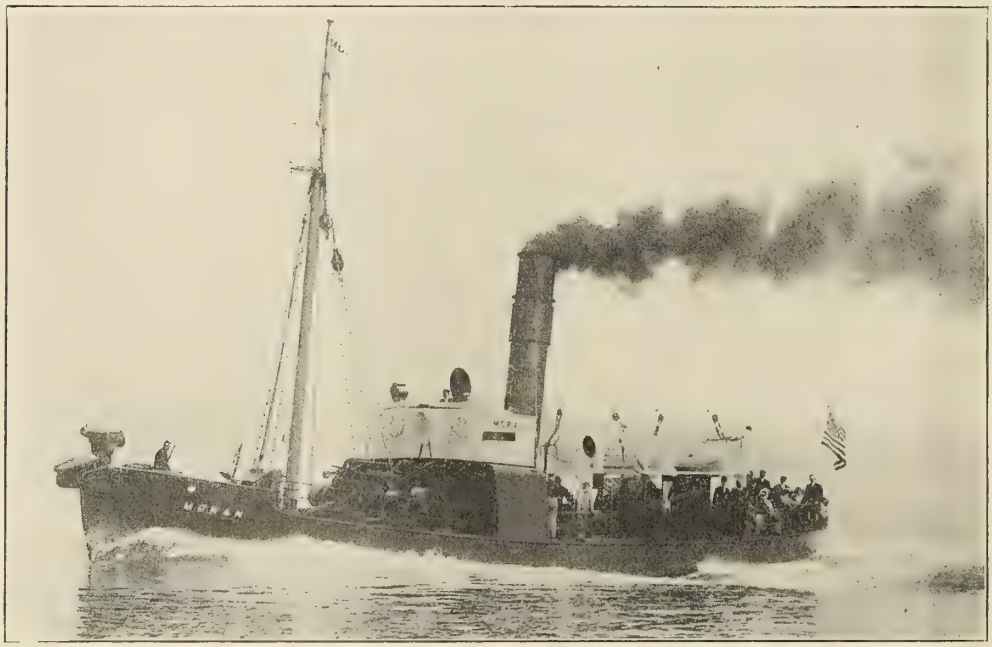
The methods of making ground joints are well known to all first-class designers, the only special point with the gas engine being that they should be so located that they might run as cold as possible. Many successful gas-engine gaskets are offered by the trade in asbestos compounds with wire mesh, asbestos compounds with cloth mesh, copper, copper-enclosing asbestos, corrugated copper with corrugations filled with asbestos-usidurian.

The coefficients of expansion for the various methods can be found in any engineering work, and by applying them first to the internal wall of the cylinder, running at a temperature of 600 degrees to 1,200 degrees, depending upon the conditions, and then to the outer jacket, running them 60 degrees to 160 degrees, one can readily ascertain if a dangerous difference of expansion exists and if the end webs are subject to dangerous stresses.

Provision for lubrication, so far as the cylinder is concerned, consists merely of passages through the jacket, by means of which the oil may reach the proper point on the piston. It is customary with most designers to allow the bore and counterbore to be so arranged that the piston ring tips each at the top and bottom. This is a refinement entirely theoretical and not borne out by practice. With the least change in adjustment of brasses one of the rings is liable to turn over, if not wreck the engine; unless the case is cast integral it is possible to get the upper ring in the counterbore so that the piston may never be removed without breaking it. An engine in which the counterbore extends from a little above the top of the piston at the end of its stroke to a little below the lower end of the piston at the lower end of its stroke is found to give perfect service in practice, regardless of the piston and the rings.

Off-set cranks have been the subject of much discussion in relation to pressure and wear on the cylinder. In a very able paper on this subject an eminent authority states that when the various elements are carefully considered, including inertia, velocity, etc., that off-setting of the cranks has very little effect one way or the other upon cylinder wear or pressure, but that it does improve lubrication slightly, and has other advantages which will be discussed in connection with pistons but does not relate to cylinder pressure. The thermal cycle is also somewhat improved, because the outgoing stroke is longer than the return, off-setting of the crank giving a quick return motion.

(To be concluded)



A 96-FOOT STEEL STEAM WHALER BUILT ON THE PACIFIC COAST

Steam Whaling Vessels

The Moran Company, Seattle, Wash., during the present year built and delivered to the American Pacific Whaling Company, Aberdeen, Wash., two steel whale hunting vessels of the following general dimensions:

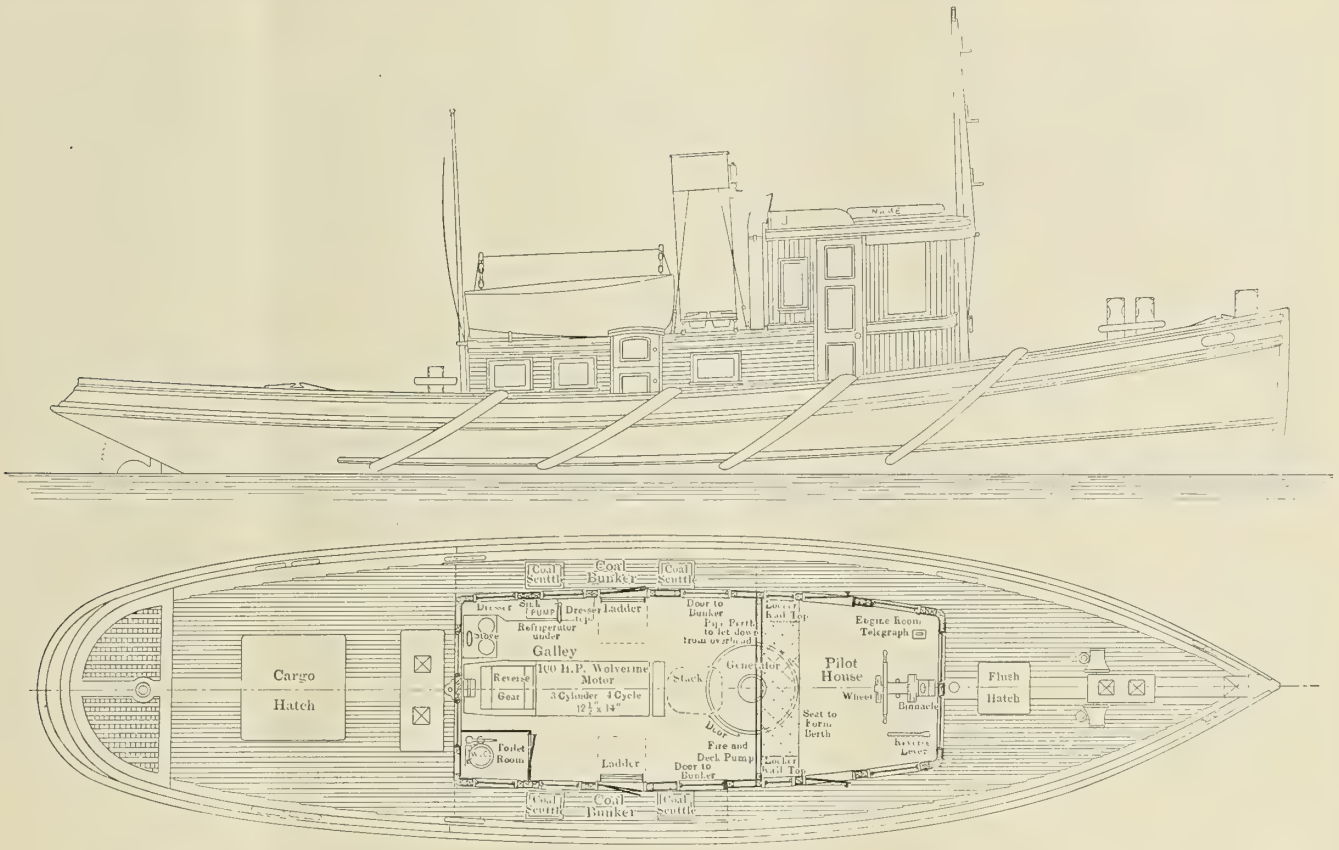
Length over all	96 feet.
Length between perpendiculars	91 feet 6 inches.
Breadth, molded	18 feet.
Depth, molded	11 feet 2 inches.

The vessels are built entirely of steel, carry one mast and funnel, and are equipped for burning oil.

They are each equipped with one single-end Scotch marine boiler and a vertical triple-expansion engine, with cylinders 11 inches, 18 inches, 29 inches diameter and 18 inches stroke, of 325 indicated horsepower, developing a speed for the ships of 12½ knots.

The most modern whale hunting devices are installed on each boat. A harpoon gun is mounted on the bow for shooting harpoons carrying explosive charges, and each is equipped with air apparatus and towing machines for pumping up the bodies and taking them to the whaling stations.

These vessels represent the most modern ideas in the whaling industry. They are named the *Paterson* and the *Moran* in honor of their designer and builders.



OUTBOUND PROFILE AND DECK PLAN OF A PRODUCER GAS TOW BOAT

Producer Gas Tow Boat

In these days, when we hear so much of producer gas, it is interesting to note the accompanying design for a producer gas towboat from the board of Wm. J. Deed, Jr., naval architect, of Boston, Mass. The design was prepared for a customer, who plans to run a route along the Massachusetts Coast, utilizing the Cape Cod Canal when ready. As there is much towing for tugs that could be done between such points as Boston and Fall River or Providence, this small towboat is being planned to be run economically on short runs, and as she will not have to round Cape Cod after the canal is in use, a smaller, hence less expensive, boat can be used.

The small tug is usually run on about 5 pounds of coal per horsepower-hour. Besides the government requirements of licensed crew the initial expense is considerably more than a gas towboat. With the producer tug no licensed crew is required, and the coal consumption, taking the figures from actual installations now in operation, will be 1¼ pounds per horse-power-hour at the most, including standing-by consumption under banked fires. Added to the economy is the very valuable asset of safety. The producer plant works on the suction principle, below atmospheric pressure, consequently no leakage of gas could occur, and the danger of bursting boiler tubes, gasoline (petrol) explosions or such mishaps is eliminated.

The hull will follow the usual steam tug practice, the arrangement offering a deck and pilot-house to house the machinery and crew of two. The towing bitts are kept well amidships, so as to permit of easy and safe handling of a tow in a seaway. The deck space is large enough to permit carrying passengers on some excursion trip or for freight. In the pilot-house are the wheel and motor controls and a berth, with lockers, for the captain. A pipe berth for the other members of the crew is located in the motor room.

In this motor room is a 100-horsepower producer, made by the Marine Producer Gas Power Company, of New York, and a 100-horsepower Wolverine (three cylinders, 12½ inches by 14 inches) motor. This plant complete will weigh, installed, 17,500 pounds, and will cost $7,500 (£1,540) installed. The fuel bill for a day's run can be easily figured and compared with other powers.

There is capacity for a large coal supply, the coal being stowed about the motor room, under the decks fore and aft, and in regular bunkers abreast the motor room. The cleaner of the producer plant is slung under the roof.

In construction this boat will be extremely strong and heavy. The model being on the hollow keel construction, a rigid deep keel and motor foundation. For such a trip as this boat will make she is eminently suited, as she is inexpensive in first cost, operation and up-keep. She can handle a couple of barges at fair speed and with ease. She is 60 feet over all, 52 feet 6 inches load waterline, 15 feet breadth over guards, 14 feet 4 inches breadth over plank, and 5 feet 3 inches draft.

Two New Naval Vessels under Construction for Cuba

The Cuban Government has manifested its intention to establish a real navy and to take over the burden of policing its own coasts and halting by its own efforts filibustering expeditions. On the 10th of the past October a cruiser and a gunboat for the Island Republic were launched at the shipyard of the William Cramp & Sons Ship & Engine Building Company, Philadelphia, and, happily, upon the anniversary of Cuba's independence.

The gunboat is intended primarily to serve as a training ship for the enlisted men and the cadets of the navy, and to that end the little vessel will be typically up to date and quite equal to the demands of the practical requirements of Cuba's service. The 7-mm. guns are to have field carriages, so that they can be used with landing parties.

Structurally, the *Patria* presents no novelties, but she is representative of the best modern practice. The boat will be driven by twin screws, actuated by two inverted, vertical, triple-expansion engines. The stroke will be of 2 feet, and the cylinders will be of 13-inch, 22-inch and 36-inch diameters, respectively. At full speed, *i. e.*, 16 statute miles an hour, the engines will make 200 revolutions a minute. Steam will be furnished by two watertube boilers of the Mosher type. These boilers will have about 100 square feet of grate surface and something like 6,000 square feet of heating surface. They will

GUNBOAT PATRIA

Copyright, 1911, by R. G. Skerrett)

bluejackets and her embryo officers. The gunboat, which is named *Patria*, has the following principal dimensions:

Length between perpendiculars	185 feet.
Beam, molded	34 feet.
Depth	22.5 feet.
Normal mean draft	12 feet.
Displacement, at 12-foot draft, salt water	1,200 tons.
Speed on measured mile per hour	16 miles.

The armament of the *Patria* will consist of the following guns:

Two 6-pounder rapid-fire guns.
Four 3-pounder rapid-fire guns.
Four 1-pounder rapid-fire guns.
Two 7-mm. machine guns.

All of these weapons are of the United States navy standard, and are mounted as follows: One 6-pounder forward and one 6-pounder aft on the main deck centerline, each gun having, respectively, a train of fire 45 degrees abaft and forward of the beam on either side; two 3-pounder guns mounted on each broadside, one at each corner of the superstructure, and commanding wide arcs of fire, and the 1-pounders, two on each side, placed amidships where they will be able to do effective

be placed in one compartment. The boat will also be fitted with a small donkey boiler. The *Patria* will be furnished with the following auxiliary machinery:

One main and one auxiliary feed pump, each of the same size, and either capable of supplying the boilers at full power.
One auxiliary condenser, with combined air and circulating pumps.
Two fire and bilge pumps of duplicate dimensions.
Two water service and salt water sanitary pumps.
One fresh water sanitary pump.
One main air pump.
One circulating pump.
One evaporator and distiller capable of supplying make-up feed and drinking water. These are of the Reilly type.
Two forced-draft blowers.
One steam ash hoist of the direct-acting steam cylinder type.
One ash ejector.

The *Patria* will be provided with accommodations in the deck-house amidships for twenty midshipmen and ten cadet engineers. Each stateroom will be arranged to hold from three to four of these young officers.

The cruiser *Cuba* will naturally be of more military value

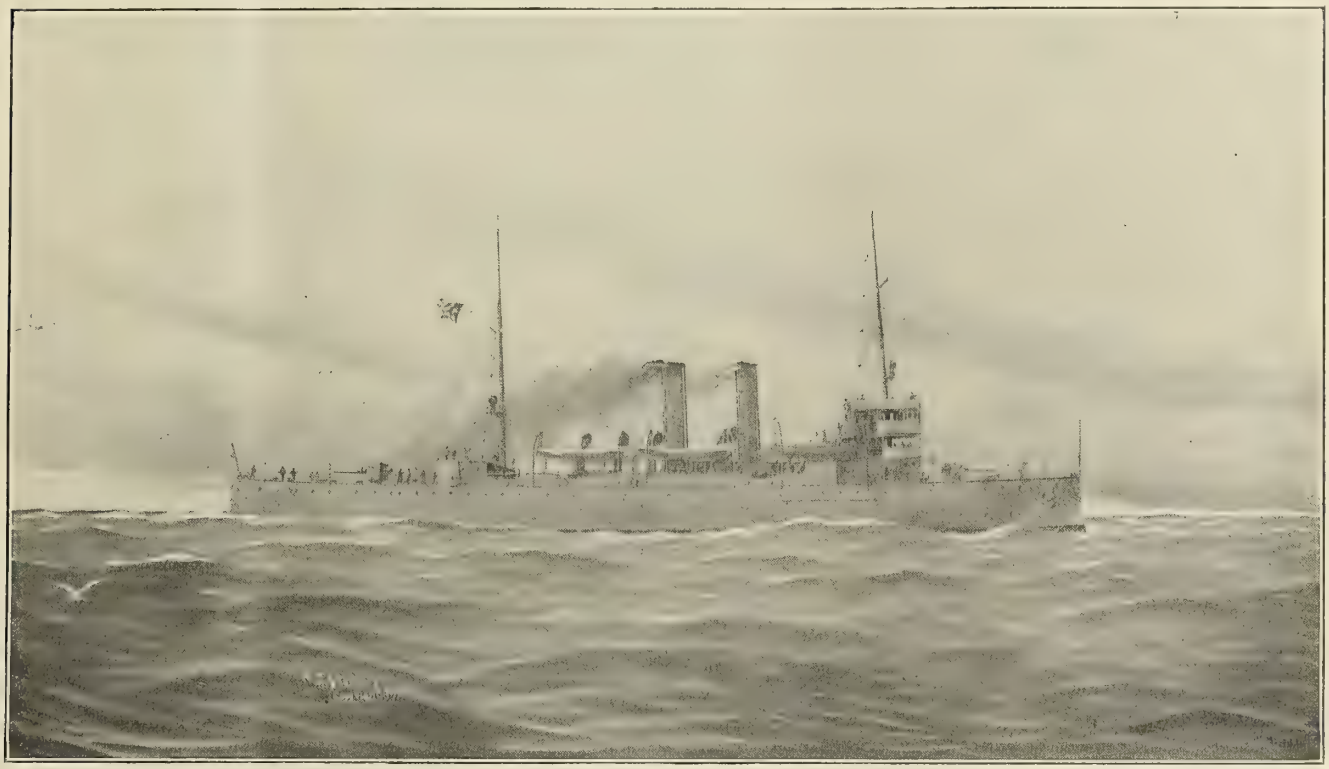
than the *Patria*. Apart from her regular naval service the *Cuba* is designed to be the yacht of the president of the Island Republic. The presidential suite is finished in mahogany, and all of the furniture will be of the same rich wood and Chippendale in pattern.

The *Cuba* has the following principal dimensions and general characteristics:

Length between perpendiculars	260 feet.
Beam, molded	39 feet.
Depth	26 feet.
Normal mean draft	13 feet.
Displacement, in salt water, at 13-foot draft	2,055 tons.
Speed on measured mile at 13-foot draft	18 miles.

a watertight protective deck, which is carried down at the sides below the waterline, so as to guard the craft against the admission of large quantities of water in case of injury in the neighborhood of the wind-and-water region. The cruiser is fitted with a double-bottom tank for reserve feed water, and other feed-water tanks will be located in some of the coal bunkers—the compartments being cemented and supplied with all necessary manholes, suction pipes, etc., for the purpose.

Both the *Cuba* and the *Patria* will be lighted electrically and furnished with searchlights. There will be two dynamos and engines of the merchant marine type provided for this purpose. The vessels will be fitted with steering engines of the Williamson Bros. pattern in conjunction with the William



(Copyright, 1911, by R. G. Skerrett) CRUISER CUBA

The *Cuba* will be armed with the following rapid-fire guns, all of United States navy standard:

Two 4-inch, of 50 caliber.
Four 6-pounders.
Four 3-pounders.
Four 1-pounders.
Two 7-mm. Colt guns for landing parties.

There will be one 4-inch gun forward and one aft on the main deck centerline, capable of training abaft and forward of the beam, respectively, on either side for 45 degrees. The 6-pounders will be mounted two on each side at the forward and after breaks of the superstructure. The two forward guns will be able to fire directly ahead as well as 60 degrees abaft the beam, while the after pair will be able to fire directly astern and to train 60 degrees forward of the beam. The 3-pounders will be mounted on the main deck amidships, and the 1-pounders will be placed between these weapons.

The 4-inch guns are protected by armored shields, and the armament of the *Cuba* is calculated to make her a very effective craft against filibusters and smugglers; in fact, a thoroughly excellent boat for the police service, for which she is primarily designed.

The *Cuba* is of steel like the *Patria*. She is provided with

Cramp & Sons arrangement for working the cross-head on the rudder stock by screw gear.

The *Cuba* is a twin-screw craft, and is to be driven by two inverted, vertical, triple-expansion engines, having cylinders of 16, 26.5 and 44 inches diameter and a stroke of 26 inches. At full speed the engines will make 160 revolutions a minute. These engines are fitted with double-bar Stevenson link reversing gears. All cylinders are fitted with piston valves. One main condenser for the two engines is to be placed in the after-part of the engine room; suitable exhaust pipes connecting to both low-pressure valve chests. Two watertube boilers, Mosher pattern, will furnish the steam. These boilers will be located in a single compartment, and will have 135 square feet of grate surface and 6,000 square feet of heating surface. There will also be a small auxiliary boiler. The boilers will be operated under the closed stokehold system, with an air pressure not exceeding 2½ inches of water when steaming at full speed. The auxiliary machinery will be a duplicate of that required for the gunboat.

Both the cruiser and the gunboat will have a wireless telegraph system, and will also be fitted with regulation Ardois light signals.

The *Cuba* will be able to stow the following supply of ammunition:

Four-inch, 200 rounds.
Six-pounder, 600 rounds.
Three-pounder, 800 rounds.
One-pounder, 800 rounds.
Seven-mm. Colts, 2,000 rounds.

The ammunition hoists, of which there will be six, are of Cramp standard type, operated either by electric motors or hand power, and similar in design to those furnished by the makers to vessels of the United States navy.

The *Cuba,* apart from the accommodations for her regular officers, will have quarters for ten midshipmen and cadet engineers.

These vessels are building agreeably to the requirements and inspection of the American Bureau of Shipping, and their combined cost, fully equipped, will represent a contract outlay of $850,000 (£175,000). The vessels will have their trial trips in the spring.

Special attention has been given to thoroughly ventilate these vessels, both by natural and induced draft, so that they may be as comfortable as possible under the climatic conditions of the Cuban waters.

Apart from these vesels the Cuban navy consists to-day of something like a dozen small craft scarcely worthy of mention except three of them, of which one is 339 tons, one of 500 tons and one of 538 tons. The other boats are generally below 50 tons with the exception of two, which boast displacements of 132 and 141 tons, respectively. These vessels have principally been engaged in coastal police and revenue service. In watching for smugglers they have had their time pretty well occupied, because the shallow, hidden waterways along parts of the Cuban shores offer very inviting cover for work of this description.

It is said that the Cuban Government is thoroughly intent upon the upbuilding of a sufficient naval force to patrol its coasts efficiently, and the two vessels building in Philadelphia are only the initial part of the programme.

Lighters and Lighterage in Harbor Freight Transference

BY H. McL. HARDING *

In studying the engineering problem of freight transference along the water front of cities, it is essential to become familiar with the various links which bind together the separated rail and water terminals. Not the least of these links are lighters, with their methods of operating, called lighterage. By lighters, and to a much less degree by drays, water-traffic lines are connected with each other and with rail traffic, and in this way is obtained a practical co-ordination of harbor terminal facilities. There is much to be learned about lighterage, at first apparently simple, but later found to be complex. In New York harbor there is a far greater tonnage of water-borne freight in the slips and piers waiting to be discharged from lighters than the land-conveyed freight from the long rows of loaded drays upon the marginal way. The active congestion is mostly in the slips about the steamships, and the passively waiting congestion upon the other side of the piers. After understanding all the movements of the freight, then being free from prejudice or preconceived ideas, it may be possible to suggest a few principles for easily adapted improvements. That branch of harbor terminal engineering pertaining to freight transference requires personal observation and experience, as little has as yet been published.

The lighter is the water dray. The lighter when covered is called a barge. The usual harbor lighter can transport from 500 to 800 tons of miscellaneous freight; the land dray from 2 to 4 tons. One lighter load may equal 200 or more dray loads.

At New York with railway freight the lighterage charge within the lighterage limits is usually absorbed in the through traffic rate. Within these lighterage limits of the port of New York, when there is a separate charge for lighterage, it is fixed by law at 3 cents per hundred pounds, or 60 cents per ton. Equivalent carriage by drays would average many times as much. Including loading, delays, congestion and unloading, the time consumed by drayage would average at least six times as long.

There is no question but that lighterage is more economical than drayage, and especially so when a fair load can be obtained for the lighter. The towage charge for moving a lighter a few hundred feet is from $2 to $3 (8/4-12/6), for distances requiring one-half hour $5 (1/0/10), and per day $100 (20/16/8). A lighter to be rented for monthly periods with the services of one man is $5 (1/0/10) per day. A number of years ago it was estimated the annual cost of drayage in New York was over $50,000,000 (£10,300,000) annually. Figures of total lighterage costs are not available.

Lighterage is a more important factor in terminal transportation in New York harbor than at any other Atlantic port. Its volume is enormous. This is due to the fact that there are but few connections between the railroads and piers. This condition has produced the great fleets of harbor transportation boats, composed of more than 10,000 craft, of which 1,100 are tugs and steam lighters. These represent an investment of at least $250,000,000 (£51,300,000), and give employment to more than 60,000 men. A large number of these vessels are operated by the transportation companies, but there are thirty independent lighterage and towing companies. As each of these lighters has a capacity from 200 to 800 tons, it will be seen how great would be the total if all could have full cargoes, probably over 5,000,000 tons. Some of the car floats, which are a modified form of lighters, are capable of carrying twenty-three full-size freight cars.

In 1908 the Lehigh Valley had 250 craft, the Baltimore & Ohio 142, and the New York Central 254. In 1907 the New York Central fleet moved 304,372 cars on floats, or about 1,000 cars per day, and in addition lightered 1,402,358 tons of bulk freight, or nearly 5,000 tons per day. Three-fourths of the harbor freight is moved in lighters and similar vessels.

There is no agreed definition of a lighter or barge, and no satisfactory dictionary authority upon which to rely. Definition of a barge in New York harbor would not apply to the barge on the Thames at London. The word bargee, from London, is seldom used along the Atlantic coast. The word lighterman is as well known here as that of stevedore. The following may be accepted as the nearest agreed definition, not, however, without exceptions:

A lighter is a vessel with a deck used for the movement of freight about harbors or in contiguous waters.

The word barge by itself in New York signifies a covered lighter; that is, a lighter wholly or nearly covered with a shed or house to protect the goods from the weather. There are other types of vessels called barges, but these are generally combined with some descriptive word, as coal-barge, ore-barge, oil-barge and schooner-barge, and the word is used with great freedom.

Lighters are of different shapes and construction, some with both ends square, others with a bow like a sailing vessel

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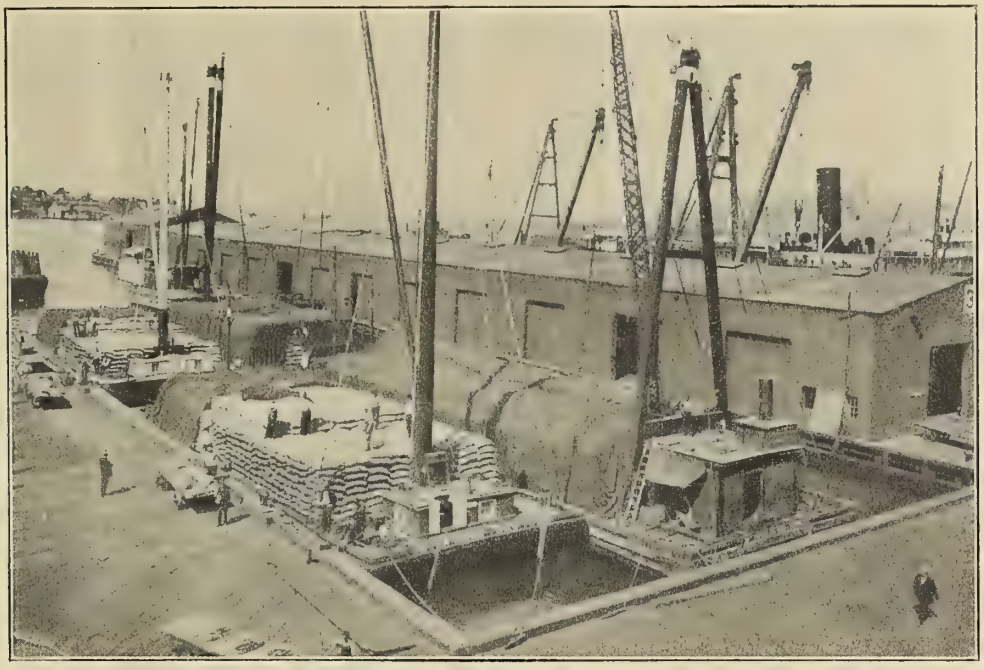
and a rounding or square stern. Some are of wood and others of steel construction. Those with square ends are considered the better, as more easily towed and having greater carrying



FOUR LOADED LIGHTERS. LIGHTER ON RIGHT EQUIPPED WITH A STEAM A DERRICK

capacity. A few still have sails, and a limited number are equipped with their own propelling power, but most are designed to be towed. The size of the covered lighter, which is preferred, is 85 to 100 feet long and 30 feet wide. Out of a fleet of forty lighters and barges two were equipped with their own power, in appearance like a large tug with a derrick and space in front for freight, which may be called express freight. Some lighterage firms make no distinction between lighters and barges. This may be due to dock and wharfage charges; North River barges paying 50 cents (2/1) per day dockage charges to the city, while lighters are assessed $1 (4/2). This is manifestly unjust.

At the port of New York the lighterage business is largely controlled by the transportation companies, but there seems to be as much fairness as is generally compatible under similar business conditions. At Philadelphia there is said to be fierce competition between the railroads and the lighterage companies. It is asserted that the freight which comes to a railroad pier must pass over the lines of the railroad controlling the pier. Generally the railroads will not allow lighters to come to their piers and take goods to other rail or water lines.

BROOKLYN PIERS, SHOWING A CONGESTED SLIP. LIGHTERS AND BARGES, TRANSSHIPMENT SHED AND RAILWAY TRACKS ALL CO-ORDINATED

At New York lighters are allowed to load at any piers. In Baltimore harbor many lighters are in service, and the different steamship lines have lighters and barges which collect freight from the various railroad and industrial piers, which freight is thus lightered to the steamship or its pier.

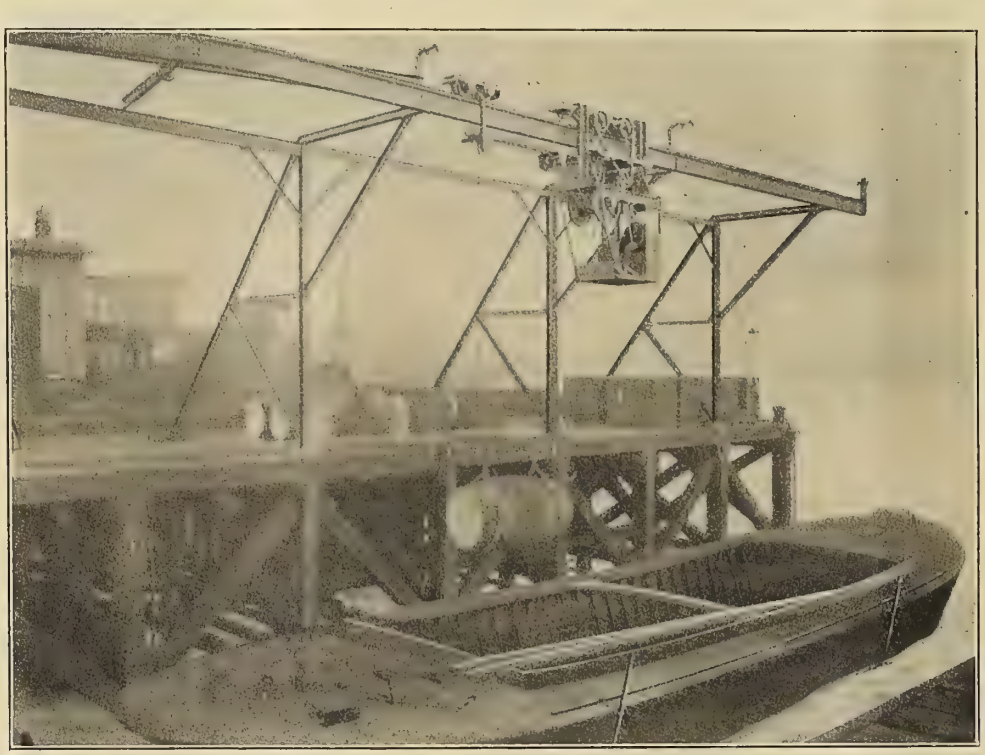
For the purpose of studying the application of machinery to freight transference it is necessary to distinguish between lighters and barges. A covered lighter will, therefore, be called a barge. The object of this paper is to ascertain whether, by means of mechanical methods, the lighters cannot be loaded and discharged more rapidly, thereby removing much of the slip congestion, and in addition reducing the expense of terminal handling between the lighters and the piers, especially when it is necessary to move the freight the whole 100 feet of distance from the landing berth of the lighter, which service may be required of the lightermen. It will make the constructive methods clearer if there is a description of the movement of the lighters and barges about the harbor.

Each transportation company in order to secure as much freight as possible makes many concessions as to the use of its lighters and lightermen. Some arrangements are public and under mutual agreements, such as free transportation within the lighterage limits, which extends from the Battery to 135th street on the North River, the Battery to Jerome Avenue Bridge on the East River, and in New York Bay along the North and East side of Staten Island. There are, however, other concessions, such as at a less than cost price for loading or discharging. The large transportation companies have their own lighters and tugs and deliver through freight free to any terminal in the harbor within the lighterage limits and likewise call for freight under certain conditions. If freight should come by a certain railroad to be delivered to a steamship company, then the railway company would load it upon one of its own lighters and transport it to the steamship or pier and there unload it. If it is to be placed upon the pier the lighterman is not obliged to move it away from his lighter more than 100 feet, and is not required to tier. Where there is not sufficient adjacent room upon the pier, then the recipient of the freight often furnishes men, without charge, to help the lighterage men to move the freight a longer distance, or to assist in tiering. The man in charge of the lighter bringing the freight generally hires his own men from the dockmen, or men are provided by the recipient transportation company and charged to the lighterage company bringing the freight.

The price for moving the freight from the pier to lighter or from lighter to pier varies per ton, according to character of the freight, being less for heavy freight, such as copper, more for miscellaneous freight, varying from 10 to 20 cents (0/5-0/10) per ton. This is supposed to be the cost of the manual labor and is charged against and in the freight rate. It means, however, only the movement between the lighter and the pier. The price charged against this freight movement may not cover the cost, but is made up in the freight charges, the securing the business being of sufficient inducement to permit here a small loss.

In many cases the freight is transferred from the steamship across the pier directly upon the lighter without rehandling the loads. In this case the loads are not transported a greater distance than if they were taken either up or down the pier and placed there instead of upon the lighter. In such a case the cost to the steamship company is no more than if the freight be placed upon its pier, and often there is but a nominal, if any, charge to the lighterage company. There being no rehandling or lifting it is possible to place the freight upon the lighter without expense to the steamship company. The great expense in terminal freight movements is not in the mere horizontal movement but in the lifting and preparing for the horizontal movement.

Lighters are often placed on the other side of the pier opposite the ship, often two or three side by side, and also alongside the pier upon the same side as the steamship if the pier be of sufficient length. Lighters are also placed upon the off-shore side of the ship along the whole length of the vessel, and often in two rows. Wherever room can be found a lighter is there squeezed in. There is naturally much congestion and



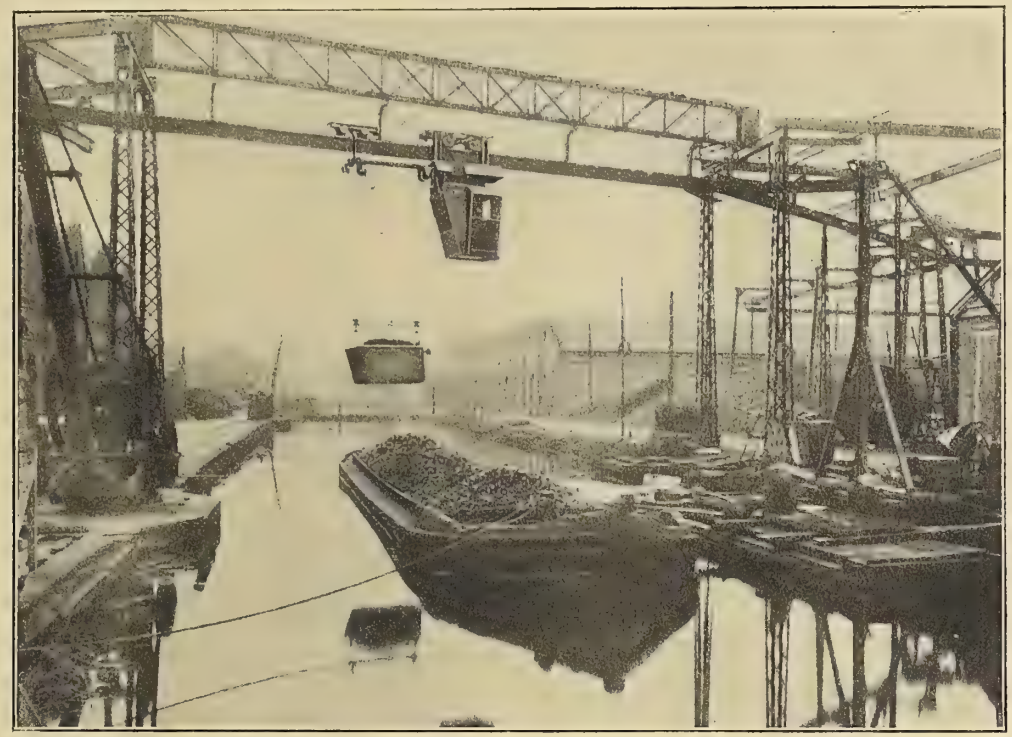
AN ECONOMICAL INSTALLATION FOR SMALL INLAND RIVER WHARVES. HIGH AND LOW WATER NO OBSTACLE

delay, but everything is done to prevent delay. As soon as a lighter is loaded or unloaded it is generally removed by the tugs of the steamship company to some convenient place, as at the end of the pier, awaiting a tug of its own transportation company, or if part of the steamship's inbound cargo it is carried to its destination within the harbor limits. A large proportion of inbound freight, if of general merchandise or for different consignees, is transferred over the piers in order that it may be inspected, assorted and distributed to the different lighters, according as each lighter is for a different destination.

An example of this is seen in cotton, each bale of which must be carefully examined for condition and for marks and crossmarks. In fact, most all of the package freight must thus be passed over the pier. A full lighter load, or in some cases

powerful hoisting machinery, some 100 tons capacity, for transferring boilers, engines or similar heavy units, from other lighters into the ship's hold. Often pieces of machinery, on account of bulk or weight, must be loaded in the ship directly under the hatches, so as to avoid the expense of moving between decks. They must therefore be held until the vessel is otherwise loaded. In order to avoid demurrage these heavy units are transferred from the foreign lighter to the deck of the lighter equipped with the powerful derrick and there retained until the ship is ready to receive them, thereby saving demurrage.

Where there is a certain amount of lighterage freight which is accustomed to be delivered to a transportation company daily or at specified times, then there is generally a space reserved for such lighters alongside the pier or vessel.



AN ENGLISH COAL BARGE. APPARATUS FOR CONVEYING COAL FROM THE BARGE TO THE REMOTE BUILDING ON THE RIGHT

less, of inbound freight for one location, or for one consignee, may pass over the ship's side directly upon the lighter.

As the freight comes from the vessel upon the pier the checkers decipher the marks and direct the load to pass across the pier or up or down the pier, and the routers point out the particular lighter, and men at the gangways opposite the lighters make another inspection of the marks as a final check against possible errors.

Lighters often do not convey their full loads on account of the expense of tiering. In one case only about 200 tons of bags of rice were placed in the barge instead of its capacity of 500 tons, on account of the labor cost of higher tiering being more than the cost of lighterage. It was cheaper to make two trips than to tier higher by manual labor.

Outbound package or miscellaneous freight almost invariably passes over the pier, so that it can be inspected, counted, checked and, if necessary, measured or weighed. Outbound bulk freight, or structural steel or similar freight, is generally taken from lighters, placed on the off-shore side. When there is not room on the off-shore side freight then passes across the pier.

One lighter and sometimes two in a fleet are equipped with

It often happens that a lighter has to deliver a part of its cargo to another company at a different pier. As far as possible the opportunity for quick unloading is afforded, but often there are vexatious delays. In such cases the lightered freight may be left upon the end of the pier some 600 or more feet from the ship's gangway, thereby greatly adding to the steamship's terminal-handling cost.

Any modern plans for harbor improvement should give careful consideration to affording ample facilities for the transferring of lighterage freight between lighters and the piers and vessels. There should be slip room between the piers equal to four or five times the width of the widest steamship to be there berthed, so that there may be sufficient space for the lighters on the off-shore side. There should be transferring machinery on the piers, and special lighters should be equipped with similar machinery, so as to load and discharge the lighters in the shortest possible time to prevent the congestion of lighters in the slips and to avoid demurrage. One of the chief functions in the organization of a harbor is rapidity of freight movements, which is facilitated by lighterage.

There is the greatest congestion and delay on the off-shore side of steamships, due to many causes, one of which is that

the freight can only be loaded into the steamer as it can be properly stowed. It will not do to stow heavy freight upon or in close proximity to fragile freight, or that which may break or tarnish that of a more delicate nature. The stowing of the freight in a steamship not only requires excellent judgment, but there must be an opportunity to select at the proper time that freight which will be best suited to the vacant spaces. It therefore often happens that a lighter is held alongside the pier away from the ship until the stevedore says he is ready to receive its cargo.

An ideal system of freight transference between steamships and lighters would be by means of a narrow pier upon each side of the ship and the lighters on the other side of these narrow piers. On account of lighters not being the only transporting agencies this is not practical, but it can be approached by equipping with modern freight-handling machinery a long lighter or float, with or without decks, which can be placed alongside the ship and other lighters alongside this float. Such a float, 250 feet long and 35 feet wide, would have a capacity when tiered only 12 feet from the floor of more than 1,500 tons. Some of the car floats in New York harbor are 317 feet in length and are easily handled, and this length could be used instead of 250 feet. By means of a machinery float of this description, properly equipped and protected from the weather, merchandise can be taken directly from lighters to the hatchways of the steamers or to the side ports without any rehandling, or can be unloaded from lighters upon this float and left with slings about them, and then, without any rehandling by manual labor, be lifted by the machinery to the vessel. The same is true of discharging. If the steamship be discharged upon this float and the float be filled, it can be moved and replaced by a similar empty float and lighters loaded from the empty float. By thus utilizing these floats, lighters can be readily loaded or discharged. The chief function of this float is providing machinery for quick, direct freight movements between the lighter and vessel on the off-shore side and also to enable lighters to be loaded from the float. There must, however, be no manual rehandling. Such machinery-equipped lighters may be considered the equivalent of an extra pier. The above might serve as one type of machinery-equipped lighter, though not by any means the only one.

Any machinery to be installed must be able to take freight from the lighters across the piers to the vessel or to any points upon the piers; that is, to be able to serve every foot of floor or vertical space, including all the usual intermediate operations, and also there should be provision for the reverse movements. All this work must be without rehandling by manual labor and with continuous rapidity. As the operations at the beginning and end of freight movements, such as assorting and lifting, distributing and tiering, are more important than the mere conveying any machinery to produce the continuous rapidity necessary must be able to hoist as well as convey.

As, by properly designed machinery installed under expert engineering advice, the freight can be lifted from the deck of the lighter, located alongside the pier or the steamship, and taken into the hatchways of the vessel without manual rehandling, the present average cost of transference can be reduced at least 50 percent, due allowance having been made for maintenance and amortization of the machinery. There can also be attained that which is considered of more importance; that is, much greater rapidity in loading and discharging. The usual precautions, so as to protect the barge freight from the weather during transit and while being loaded or discharged, have received careful consideration. The one dominant provision to which everything else has been subordinated, so as to secure rapidity, economy and the least breakage, has been freedom from rehandling by manual labor.

The British National Experimental Tank

BY PROF. HAROLD A. EVERETT

The idea of a National experimental tank in England and its realization are both due to Mr. A. F. Yarrow. At the Glasgow meeting of the Institution of Naval Architects in 1901 he proposed that an experimental tank should be established under the auspices of the Institution, at which model experiments should be carried out for shipbuilders and others, and a committee was appointed to take steps to realize this. Sir William White, in his paper read before the Institution in 1904, emphasized the opinion expressed by the president, the Earl of Glasgow, in his address to the Institution in 1903, when dealing with the work of this committee, that the establishment of a tank for the purpose of systematic research into general principles was an urgent matter, and that such a tank should be located at the National Physical Laboratory. Mr. Yarrow's generosity made this scheme possible, when in April, 1908, he offered to find the sum of $97,500 (£20,000) for the construction of the tank, provided suitable provisions were made for conducting research work and for experimental investigations of a confidential character. With this object he suggested that a guarantee fund of $9,750 (£2,000) a year for ten years should be raised.

In response to this offer the Institution of Naval Architects raised a fund of $6,525 (£1,340), and the executive committee of the laboratory undertook the responsibility of finding the additional sums required to work the tank. An advisory committee, consisting largely of representatives of the Institution, has been appointed with a view of keeping the work of the tank in touch with the needs of shipbuilders and naval architects, and the tank itself is to be opened just ten years after Mr. Yarrow's first proposal.

The following is a brief description of the tank and of the apparatus installed:

The Large Tank

There are two water basins, the largest constructed of concrete, varying in thickness from 2 feet to 4 feet in places. The dimensions of this basin are:

Length	550 feet.
Breadth	30 feet.
Depth	12 feet 3 inches.

It is provided at the north end with docks for storage and for easy access to the models, at the south end with a shelving beach to eliminate the waves formed by the models.

The models used for experiments in this basin will vary in length from 14 to 20 feet, and will be towed along the waterway from a carriage, electrically driven, which runs on rails secured on either side to the top of the tank walls. This carriage will travel at any speed from 1 foot per second to 25 feet per second.

The equipment of the carriage consists of a grip for holding the model during the acceleration and retardation periods; guiding frames at each end to keep the model on a straight course without restricting its vertical motion; a spring dynamometer by which the model is towed when a steady speed has been reached. The speed of the carriage is obtained by recording time and distance, the former being given by a clock which makes and breaks each half second, and the latter by an electromagnet, the circuit of which is completed by catches fixed on the rails at 20-foot intervals.

The Small Tank

The dimensions are:

Length over all	63 feet.
Breadth	5 feet.
Depth of water	3 feet 3 inches.

A rotary pump is fixed in the tank at the north end, which

will enable model experiments with flowing water to be made. For still-water experiments pits 16 feet deep have been constructed on the middle line at each end of the tank. The model will be propelled and retarded by dropping and raising weights in either pit, the pull of the weights being transmitted to the model by a fine wire. The speed of the model will be measured by a vibrating rod of known frequency.

Model Making

The models are made of paraffin wax. The wax is heated in a tank surrounded by hot water which is kept circulating by a small boiler. The castings are made in a clay mold. The tank containing the clay is arranged so that two molds for 20-foot models may be prepared at the same time. A traveling cutter is arranged on top of the mold tank for trimming the upper surface of the castings.

The models are shaped to the correct form by cutting a series of horizontal grooves in them on a special machine, and trimming the wax down by hand to a fair and smooth surface, leaving only the finest trace of these grooves. The shaping machine will deal with models of a maximum length of 25 feet. A table for measuring the finished model or marking any desired lines on the model has been installed.

Steam Trawlers Surf and Swell

The steam beam trawlers *Surf* and *Swell* were launched Dec. 9 at the yards of the Fore River Shipbuilding Company, Quincy, Mass. Following are the general dimensions:

Length between perpendiculars	120 feet 6 inches.
Length over all	129 feet 6 inches.
Breadth, molded	22 feet 6 inches.
Depth to main deck	13 feet 6 inches.
Mean designed draft	10 feet 6 inches.
Indicated horsepower	400

These vessels have straight stem, semi-elliptical stern, raised quarter-deck and turtleback topgallant forecastle, and are rigged as pole-masted ketches. The fish hold has a capacity of 50 tons of iced fish, is insulated throughout with cork and sheathed with spruce, and is divided into bins fitted with portable sides, so that the catch after being sorted in the ponds on deck may be stowed, having the different classes of fish entirely separated.

On the main deck directly over the fish-hold there is an ice-crushing machine, through which about 10 tons of commercial blocks of ice can be fed into the hold, broken up into small pieces of a size best suited for the preservation and stowing of fish. The engine for running this ice crusher is so arranged that it can be used for handling the cargo on arrival at the fish wharf.

There is a turtle deck forward, and upon this deck is located the anchor-handling gear. On the main deck forward there is a steel deck house, containing lamp and paint rooms and entrances to the forecastle and cargo. On the quarter-deck aft, and embodied with the engine casing, is another deck-house of steel, which contains quarters for two firemen and entrance to the cabins and engine room. In the forecastle are pipe berths and lockers for the accommodation of fourteen men, with a galley and mess room located just aft of the forecastle, containing a shipmate range, refrigerator and ice-box and the necessary equipment and outfit for the accommodation of the entire crew and officers. In the after cabin there are four berths, with the usual lockers, seats and table, as required for the accommodation of the ship's officers. The captain's cabin is located on the port side and a cabin with two berths for the engineers on the starboard side.

For handling the trawl nets and otter boards there are the usual gallows frames and an 8-inch by 14-inch double-drum winch, supplied by the Hyde Windlass Company, together with the necessary revolving bollards and fittings to give the required leads for trawl lines.

The vessels are lighted throughout by electricity, the generator set being one of 2½ kilowatts, 110 volts, built by the General Electric Company.

Steam is supplied by one Scotch boiler having a working pressure of 180 pounds, and is of 12 feet 6 inches mean diameter and 10 feet 6 inches long, with two Morison suspen-

LAUNCHING OF THE SURF

sion furnaces 42 inches diameter, having a heating surface of 1,568 square feet and a grate area of 42 square feet. The main engine is of the triple-expansion vertical type, having cylinders of 12¾ inches, 22 inches and 36 inches diameter by 24 inches stroke, developing 450 indicated horsepower at 110 revolutions per minute. The condenser is cast onto the back columns of the main engine, and the air, bilge and feed pumps are driven off the intermediate-pressure crosshead.

Personal

Mr. Sidney G. Koon, M. M. E., for four years editor of International Marine Engineering, and later metallurgist for the Jones & Laughlin Company, is now associated with Mr. Walter B. Snow, publicity engineer, 170 Summer street, Boston, Mass. Also a short time ago Mr. John S. Nicholl, B. S., lately with the New York Edison Company, and formerly acting manager with F. W. Horne, importer of American machinery, Yokohama, Japan, became associated with Mr. Snow's staff.

Obituary

A. Cary Smith, 74 years of age, famous as a designer of racing yachts and merchant vessels, died Dec. 8 at Bayonne, N. J. Mr. Smith designed one of the America's Cup defenders and many schooners, sloops and yawls that have crossed the Atlantic and were consistent winners of races for years. Among the steam vessels designed by Mr. Smith were the *Richard Peck*, the *City of Lowell* and the *Chester W. Chapin*, and the yacht *Meteor*, built for the Kaiser.

Latest Dreadnoughts for South American Republics

In beginning the upbuilding of strong naval powers, consistent with the natural resources and rapidly-growing industrial and commercial importance of the largest and strongest South American Republics, it must be expected that the latest types of battleships and destroyers should be adopted, and it is not surprising to find that the initial steps in this direction have resulted in the creation of dreadnoughts larger and more powerful than any that had been constructed by other naval powers at the time of their design. Of most interest is the recent naval construction for Argentina and Brazil.

Argentine Battleships

The recent launching of the *Rivadavia* at the yards of the Fore River Shipbuilding Company, Quincy, Mass., May 26, 1911, and the *Moreno* at the yards of the New York Shipbuilding Company, Camden, N. J., Sept. 23, 1911, give an opportunity to recapitulate the main characteristics of these dreadnoughts and compare them with the recent additions to the Brazilian navy. The Argentine battleships have a normal displacement of 26,500 tons at a draft of 27 feet 6 inches. The full-load displacement is 27,500 tons. The principal dimensions (see International Marine Engineering, May, 1910) are: Length over all, 604 feet; length between perpendiculars, 585 feet; beam, 95 feet 6 inches; depth, 49 feet 7 inches. The total weight of armor is 7,600 tons, 680 tons of which consist of nickel steel, disposed so as to protect the hull from mine and torpedo attack. The main armor includes a 12-inch belt at the waterline 200 feet long, which is reduced to 10 inches for 75 feet further at each end and finally tapers to 5 inches at the ends. Above this throughout the length of the vessel is a belt 9 inches thick tapered to 8 inches at the upper deck. Six-inch armor forward and 4-inch aft is used in the upper part of the structure.

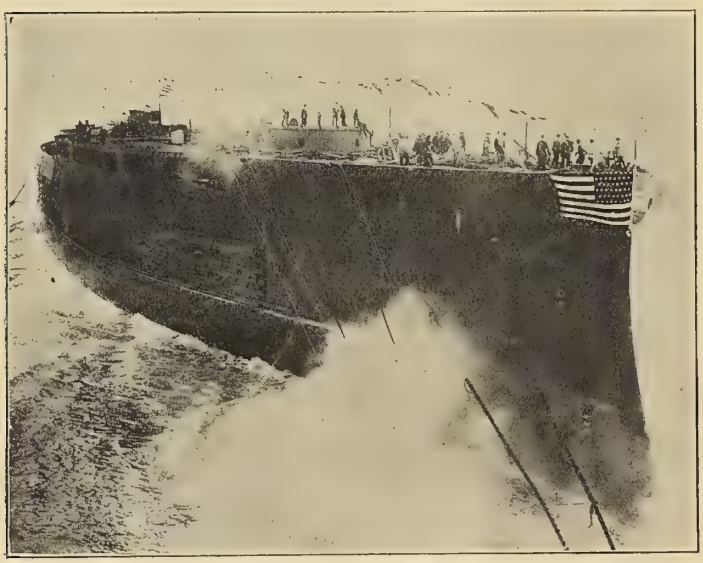
The armament consists of twelve 12-inch 50-caliber guns mounted in pairs in six turrets, arranged to fire on either broadside, and six of them forward and six aft. There are also twelve 6-inch 50-caliber guns in the main citadel and twelve 4-inch 50-caliber guns.

The vessel is propelled by triple screws driven by Curtis turbines, with a total horsepower of 39,500. The turbines are located in three separate compartments, and steam is provided by eighteen Babcock & Wilcox boilers, fitted to burn both coal and oil, and located in six watertight compartments, three of which are forward and three aft of the engine rooms. The bunker capacity includes 4,000 tons of coal and 660 tons of oil, giving a radius of 10,500 miles at 11 knots, 7,200 miles at 15 knots and 3,600 miles at 22.5 knots. The designed speed of the ship is 22.5 knots.

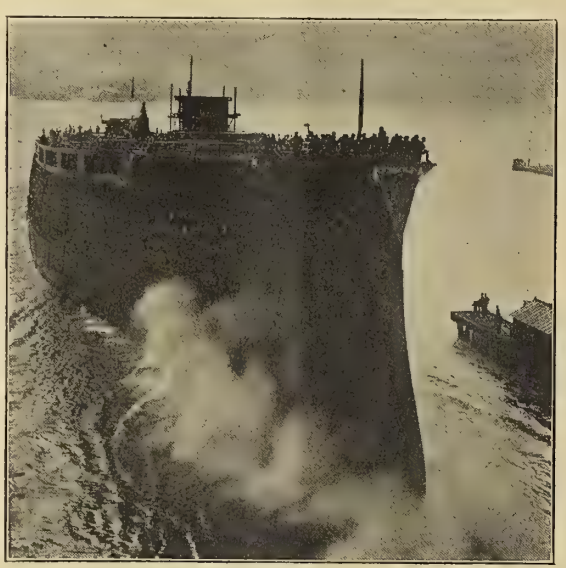
Launching Details

Nice engineering judgment is involved in bringing a big ship to a standstill after she leaves her launching ways. Theoretically, the problem seems a very simple one, but the case of the *Rivadavia* at the Fore River yards furnishes a very pretty example of the way in which calculation has to be tempered by good judgment in order to secure a successful launching. The *Rivadavia's* launching weight was just under 11,000 tons. In calculating the resistance required to check the *Rivadavia* after she was afloat it appeared that the accumulated energy of the ship, just as she left the ways, would amount to about 7,000,000 pounds. This amount of resistance was to be applied in the shape of manila rope stops connecting fixed chains to chains attached to dogs on the vessel's bow. On each side of the ship there were four sets of heavy chains, two fixed, these being anchored to "dead men" sunk deep in the ground; the other two being attached to dogs on the ship. The ship's bow before launching was about even with the anchors of the land chains; the ship chains on each side were first laid aft well onto the quarters, and were then brought forward again towards the bow until their shore ends nearly reached the anchors of the fixed chains. On each side of the ship, therefore, a land chain and a ship chain lay parallel on the ground for a distance of about 400 feet. The chains thus paired were connected by fifty-two stops, or rope cable joinings, in each pair; the stops were about 20 feet long, and the last two of each group of fifty-two—that is to say, the two which would break last—were double. The resistance offered by the cable stops, therefore, was the breaking strength of 200 single strands of manila cable, plus the breaking strength of eight sets of double strands.

Here judgment enters. The blocking under the stern of the



LAUNCH OF THE RIVADAVIA



LAUNCH OF THE MORENO

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ship, between the stern and the sliding ways, would offer considerable resistance as the ship slid stern first into the water; but it was obviously impossible to calculate with any accuracy the amount of this resistance. Another variable was the condition of the grease with which the ways were flushed. All previous battleship launchings at the Fore River yards had been in November, so the August heat had to be considered. A certain softening of the grease, provided that this softening did not result in making it too thin, would give the ship more than the calculated speed based simply on her weight and the inclination of the ways. The calculation showed that 8-inch manila cable would offer ample resistance, but Manager Smith, of the Fore River Company, decided to use 9-inch cable, and the result justified his judgment.

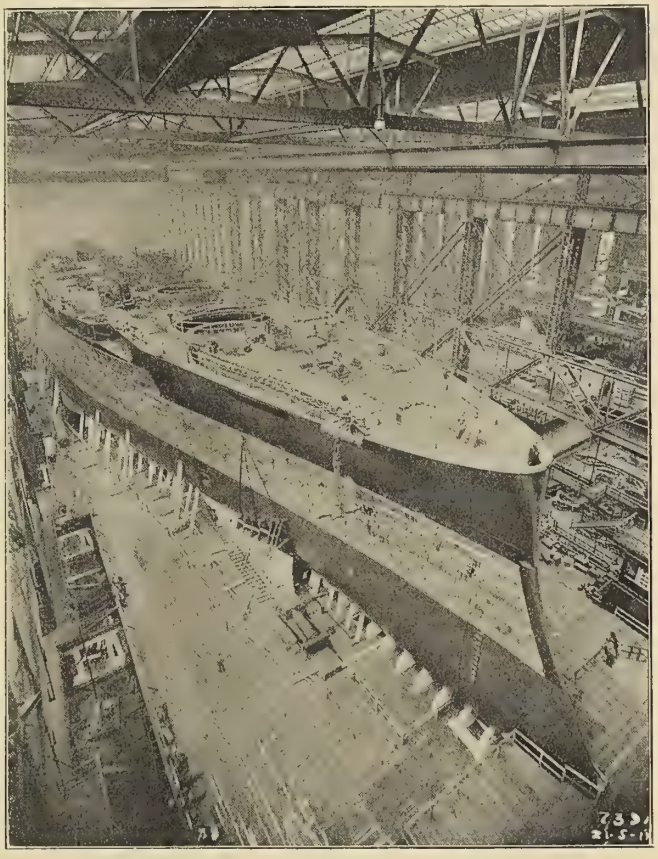
The stops were therefore made of 9-inch manila cable, manufactured by the Plymouth Cordage Company, and having an estimated breaking strength of 65,000 pounds. A 20-foot stop of this cable stretched about 6 feet before breaking, and the successive stops between the chains were so arranged that the second stop came under strain and began to stretch before the first one was broken, while the third stop came under

MANILA STOPS USED AT THE LAUNCHING OF THE RIVADAVIA

strain before the second stop was broken, and so on down the line. This arrangement provided a nearly constant resistance to the momentum of the ship, the heaviest resistance being provided in the four double stops at each side, which would come into play only when the ship had presumably lost most of her headway. As a matter of fact, every stop, both single and double, on each side of the ship broke, and the ship came to a standstill in the water less than 10 feet from where the last stop gave way. The expenditure of first quality manila cable was necessarily very large; 24,000 pounds of the finest Plymouth manila rope were used for the stops, and this 12 tons of cable was destroyed in less than ten seconds, that being the period of time during which the resistance of the rope was used to bring the vessel to a stop.

THE BRAZILIAN BATTLESHIPS

The Brazilian navy may be divided into two distinct parts—the present fleet and the vessels ordered in Great Britain under the administration of President Affonso Penna, according to the 1906 naval programme. The present fleet may be said to be composed of thirty-one units, including eight small vessels for the patrol of the inland river stations and three transports. These ships are all somewhat old, with the possible exception of the two coastguard cruisers *Deodoro* and *Floriano*, of 3,162 tons each, and the four torpedo destroyers, *Tupy, Tymbira, Tamoyo* and *G. Sampaio*, of 1,190 tons. The



VIEW SHOWING DECK ARRANGEMENT OF THE MORENO

cruiser *Barroso*, of 3,450 tons, is to be turned into a modern training ship. The new Brazilian fleet is composed of three battleships of no less than 19,280 tons each, the *Minas Geraes*, the *Sao Paulo* and the *Rio de Janeiro;* two scouts, the *Bahia* and the *Rio Grande do Sul;* ten torpedo boat destroyers of about 560 tons displacement; three submarines and two auxiliary vessels. The *Minas Geraes*, built by Sir W. G. Armstrong Whitworth & Company, Ltd., and the *Sao Paulo*, built by Messrs. Vickers, Sons & Maxim, Ltd., were delivered at Rio Janeiro in the fall of last year.

The *Minas Geraes* and *Sao Paulo* are sister ships, and the following is a table giving their main features:

Length over all	543 feet.
Length between perpendiculars	500 feet.
Breadth, molded	83 feet.
Depth, molded	42 feet 3 inches.
Draft	25 feet.
Displacement at 25 feet draft	19,280 tons.
Speed at full power	21.623 knots.
Indicated horsepower	28,645
Normal coal capacity on 25-foot draft	800 tons.
Total bunker capacity	2,360 tons.
Radius of action determined on 48 hours' trial at 10.6 knots	12,813 sea miles.

ARMAMENT

Twelve 12-inch 45-caliber guns.
Twenty-two 4.7-inch 50-caliber guns.
Eight 3-pounder guns.

ARMOR

Broadside, 9-inch, 6-inch and 4-inch cemented steel.	
Protective deck	2 inches.
Main bulkheads	9 inches.
Gun barbettes	12 inches.
Forward and after athwartship bulkheads	3 inches, 4 inches.

MACHINERY

Engines, triple-expansion, four-cylinder type.
Diameters of cylinders, high-pressure, 39 inches; intermediate, 63 inches, and two low-pressure, 73 inches; stroke, 3 feet 6 inches.
Total cooling surface of condensers....24,000 square feet.
Boilers, 18, Babcock & Wilcox type.
Heating surface.....58,370 square feet.
Grate area..... 1,686 square feet.

The difficulty of accommodating such extensive gun equipment, while affording the maximum arc of training for each gun, falls upon the naval architect. The weight involved for a pair of 12-inch guns—approximately 500 tons, exclusive of the 9-inch armored walls of the barbette, which add 100 tons—makes it imperative that in action the guns should be of the greatest service. This is the more essential when one also reflects upon the cost of training and maintaining the gun crews. The engine designer, on the other hand, makes great demands upon the deck space for his boiler up-takes and engine-room ventilating shaft. The ultimate test of efficiency rests upon the compromise made between the two claims. The two boiler up-takes occupy the minimum of deck area, and the after one is ingeniously arranged in order to overlap, to a certain extent, the two engine-room shafts. Around the up-takes is built a superstructure, on the lower platform of which there is arranged, forward, adequate latrine accommodation for the men whose quarters are in the main and middle decks below, and aft the cuisine department, with its extensive stores. The upper platform serves as an officers' promenade, and around it are hammock-stowing cases, which afford protection against small gunfire. The boats are housed on the top of this superstructure, with the exception of the two "sea" boats, which must always be slung for immediate lowering. These boats are carried on one heavy double-derrick structure on each side, built up of channels and braced with transverse channel irons and diagonal bars. These derricks are pivoted at their base, and by means of the boat hoists can be canted outwards to enable the boats to be lowered. The ordinary boats are shipped and unshipped by hydraulic hoists on the superstructure deck and derricks fitted to the vertical member of the tripod mast. On this mast there is carried the gun-control station, with yards for signaling and the aerial telegraph wires. The superstructure essential to boilers and machinery, to give a maximum of about 25,000 horsepower, thus occupies less than one-third of the length of the ship, and a like proportion of the width.

Forward, as well as aft, it has therefore been possible to fit two gun-houses in the center line of the ship, these each accommodating two guns of 12 inches bore and 45 calibers in length. Amidships, on each side, there is a similar gun-house; and in order to allow the immense armor hood protecting the ordnance machinery to rotate through 180 degrees the deck structure is cut away in a semi-circle. Otherwise the upper deck of the ship is free of obstruction. This freedom from obstruction is one of the notable features of the ship. Four of the gun-houses are on the upper deck level, but the after of the pair of turrets forward and the forward of the pair of turrets aft are on a level some 12 feet above these, so that the guns in this case may fire over the guns in front of them. The centers of the turrets of each pair are about 36 feet apart. Thus eight guns may fire forward, including the four amidships, eight aft and ten on either broadside. In this way, it will be recognized, an unusually high proportion of gun power is utilizable under any conditions of warfare, while the higher elevation of four of the guns gives them a very considerable advantage.

The central superstructure in the ship has been utilized for housing at the forward end, on two different levels, four 4.7-inch guns, two on each side of the bridge, firing forward in line with the keel, with a considerable angle of fire abaft the beam, while aft there are also four such guns similarly arranged. Six 3-pounder guns have been housed in the superstructure, and two others are placed one on the top of each of the higher 12-inch gun-houses, forward and aft. In addition, there are on the main deck, and therefore within the citadel of 9-inch armor, seven 4.7-inch guns on each side of the ship. The upper works forward and aft are indented, in order that the forward and aft 4.7-inch guns on each side may fire ahead or astern in line with the keel as well as the beam. There are in all twenty-two 4.7-inch guns. The broadside fire, therefore, aggregates ten guns firing 850-pound projectiles, eleven guns firing 45-pound projectiles, and six guns using three-pounder projectiles. As in each case great rapidity of fire has been ensured, the armament constituted the most formidable attack yet provided for in any battleship afloat at that time.

To conform to the desire of the Brazilian authorities, electricity is utilized for the training of the turrets. Otherwise, hydraulic power is applied, and for every operation there is emergency gear, either of the hydraulic type or for manual working. Air blast is fitted for clearing the gun immediately after each round has been fired, and there is a water spray on the rammer, which plays upon the obturator pad immediately the breech is open, to ensure that any sparks then remaining may at once be extinguished. The guns are arranged to be operated through eighteen degrees of elevation, and the gear is so designed that the guns must be loaded at five degrees of elevation. The hydraulic power for elevating each gun is normally under the control of the captain of the turret, but for loading operations the main valve is thrown out of gear, so that the gun at once returns to the five degrees of elevation, and, having been loaded, is again placed under the control of the captain of the turret for elevation to suit the objective. The recoil is taken up by hydraulic cylinders in the usual way.

The loading machinery is on the two-stage system, so that there is no possibility of the magazine being jeopardized by any accident at the gun platform. The shell rooms under each turret are sub-divided, and in this connection it may be stated that a shell chamber has been arranged between the two engine rooms. The shells are traversed from their bins by an overhead hydraulic traverser, using toggle-jaw clips, and arrangements have been made so that this traverser can be worked by hand. A circular traversing rail is arranged round the hoist trunk, and the tray for loading the projectile into the hoist cage travels with the trunk when the turret is being trained. The door admitting the shot into the cage is interlocked with the cage itself. The charges of ammunition are loaded by hand on the level above the shell rooms. The charge is put into a hopper in the central portion of the trunk, and falls into the upper tray of the hoist cage. The cage is elevated by an hydraulic ram working through rope gear to the working chamber level, where the charge and projectile are driven by an hydraulic rammer into the upper or gun-loading

hoist cage, which travels to the gun-loading position on guide rails set to the required curvature. The breech of the gun having been opened, the upper travel of the cage tilts a loading tray into the breech of the gun, in order to protect the screw-thread of the breech. The rammer in use is of the usual chain type, and its first motion locks the cage, which must, consequently, remain in position until the gun has been loaded. When the chain rammer is withdrawn from the breech the cage falls, and the tilting tray is then automatically withdrawn. The tilting tray has a locking bolt fixed to a slide arm, which locks the valve of the breech opening and closing motor, so that the breech block cannot be operated during the process of loading. It will thus be seen that from first to last every action must follow the proper sequence from the moment the charge is put into the hoist at the base of the turret until the gun is loaded and the breech closed again.

The lower and upper cages can be worked by two distinct hydraulic systems, electricity being used to supply the emergency hydraulic power. The turret is trained by a variable speed motor, a separate installation of motor generators being provided in each turret to supply the current, and there are suitable resistances to compensate for the variable speeds required. The worm-wheel is fitted with friction plates, which are kept up to their work by Belleville springs, so that there can be no shock upon the motor should the training gear come hard back against the stops on the turn-table roller path. On the worm-shaft two bevel wheels are fitted for transmitting, through chain gear, the manual power for training the turrets. The electric current for training the turrets is supplied from the main electric installation on board the ship, which include six generating sets, consisting of engines and dynamos, the collective electric power being 3,600 amperes at 220 volts and 400 revolutions. There are three hydraulic pumps, in separate engine rooms—two forward and one aft—connected with one system of pipes, the pressure being 1,000 pounds to the square inch. One of these pumps is practically sufficient to operate the six turrets.

Great care has been exercised in connection with the cooling of the magazines, and four of Hall's CO_2 machines are provided with a collective capacity of 300,000 cubic feet of air per hour—a capacity greatly in excess of that hitherto fitted. This is due to the hot climate in which the ship will usually be serving. Part of this cooling capacity may be utilized in connection with the food stores.

A special feature of the turrets is the large space allowed for the operations. The gun-houses seem larger than usual. The side plating is in one piece, while the tops are in two pieces only, with a junction down the center. The front, being 12 inches thick, has had to be made in three pieces to form the gun ports.

The broadside armor amidships is 9 inches in thickness for a depth of over 22 feet 4 inches, 5 feet of which is below the normal load waterline. Forward and aft there is a transverse bulkhead, 9 inches thick, enclosing the barbettes. Forward and aft the waterline belt is reduced first to 6 inches and then to 4 inches at the ends. The upper strake amidships, extending to the top deck, is also of 9-inch armor, and within the citadel thus formed are the 4.7-inch guns on each side. There are two protective decks, the waterline deck being 2 inches thick and the upper one 1¼ inches thick. The 9-inch plates on their trial were subjected to three rounds, the striking energy in each case being 9,300 foot-tons. So satisfactory was the resistance to this attack that it was decided to fire a supplementary round, with a striking energy of 10,300 foot-tons. The result of this was exceptionally satisfactory, the penetration in no case being 2½ inches.

Mr. J. R. Perrett, F. R. S. N. A., the naval constructor of the Elswick firm, who was responsible for the design of the *Minas Geraes*, and who therefore deserves great credit for the increase in gun power, propulsive efficiency of the vessel and satisfactory disposition of the ordnance, must also be congratulated on the arrangement of the accommodation for the personnel, for which large provision had to be made. A study of the complement of the new Brazilian warships shows that the ratio as compared, for instance, with British ships, is as 7 to 5. Although this increase may not be proportionately so large in the case of officers, there is the fact that cabins are provided for a larger number of petty officers in the Brazilian fleet than in the British and other navies. As a consequence a greater number of staterooms had to be provided. All the officers are accommodated aft on the main and middle deck, and in view of the large range of temperature experienced in South America special care has had to be exercised to ensure healthy conditions. On both the main and middle decks there is a range of cabins on each side of the ship, and in the middle deck an innovation in warship design has been introduced by the adoption of double cabins, inner and outer. The public rooms, too, occupy the whole of the intervening space, the cabins opening direct on these public rooms. This was arranged at the instigation of the Brazilian authorities. There are obvious disadvantages with such an arrangement, notably the fact that the officers in the public rooms enjoying social intercourse may disturb the rest of their colleagues in the staterooms, while it is unavoidable that the companionways must lead direct into the public rooms. On the other hand, there is better ventilation, which in the hot climate of Brazil is an undoubted advantage. In addition there has been introduced the thermo-tank system of ventilation, ensuring a constant supply of air, heated or cooled, according to the atmospheric temperature prevailing, to every room and living space in the ship. Another feature is the adequacy of lavatory and bath-room accommodation. Indeed, so extensive is this that there is a probability that when the vessel is on service all the ordinary wash-tank basins will be dispensed with, as they are more or less a source of danger to health if the dirty water tanks are not immediately emptied. There is to be added also the luxury of the barber's shop, with its equipment for chiropody, etc. The sailors' quarters are also in advance of modern practice, and the sick bays have had very great care bestowed on their location and equipment.

The machinery was designed and constructed by Messrs. Vickers, Sons & Maxim, Ltd., of Barrow-in-Furness. The main engines are of the reciprocating type, and their adoption, notwithstanding the experience of the firm concerned with turbine machinery, is a fact to be noted. It is probably due to the desires of the Brazilian naval authorities. As the *Sao Paulo* and *Minas Geraes* will most frequently be run at low power, the cost of maintaining the ship in service will be very low. As regards vibration, the performance of the vessel at all speeds was very satisfactory, a consequence of the long experience of the builders of the machinery. The engines are of the four-cylinder, triple-expansion type, and the working parts have been proportioned to balance the couples. The diameters of the cylinders are: Thirty-nine inches in the case of the high-pressure, 63 inches the intermediate, and 73 inches for each of the low-pressure cylinders, all having a stroke of 3 feet 6 inches. The distribution of steam is controlled by a single piston valve in the case of each high-pressure cylinder, double piston valves being provided for each intermediate cylinder, and flat triple-ported slide valves for each low-pressure cylinder. The whole of the valves are actuated by valve gear of the double-bar Stephenson type, and the low-pressure valve gear is fitted, in addition, with Joy's patent assistant cylinders. Double-cylinder steam engines working "all-round" gear are fitted for reversing purposes, and similar engines are provided for turning the main engines. All the cylinders are separate and independent castings, each being fitted with a separate liner and steam jacketed. The cylinders

are supported at the front by wrought steel pillars, and at the back by cast iron columns carrying the guide faces. The bed-plates are of cast steel, the shaft bearings being of gun-metal, lined with white metal, and secured with wrought steel keeps. The crank and tunnel shafting is of forged steel and hollow. The propellers are three-bladed, the bosses and blades being of manganese bronze. The engines are arranged to run inwards when going ahead, the starting platform being in the center of the ship. One condenser is placed on the wing side of each engine-room. The total cooling surface is 24,000 cubic feet. The air pumps are of the independent twin type, and are placed one in each engine-room in the wings. This gives a very roomy compartment, with access to all parts. This is the more satisfactory as a large shell room and magazine is placed between the engine-rooms.

The boilers, eighteen in number, are of the Babcock & Wilcox latest type, and are arranged in three boiler rooms, the total heating surface being 58,370 square feet and the grate area 1,686 square feet. The supply of air to the stokeholds is provided by ten steam-driven fans. Weir's pumps supply the boilers with feed-water. Ash ejectors and the usual ash hoists are fitted in each boiler room, and there are air compressors for sweeping the boiler tubes and other services. A complete installation of evaporating and distilling plant is provided in each engine-room, while in a separate compartment, on the deck above, two cylindrical return-tube boilers provide steam for the auxiliary machinery throughout the vessel when the ship is in harbor.

The full speed attained with the *Sao Paulo*—21,623 knots—practically equals the average rate attained by the British dreadnought battleships, although special care had to be exercised in the design of the machinery in order that the steaming conditions might be easily met when using such coal as is readily available in South America, since this may not always be of the high calorific value of the better anthracites, and in order, also, to meet any deficiency in the skill of the stokers. Thus, for instance, the proportion of heating surface to grate area is about 36 to 1, as compared with from 30 or 33 to 1 in the British service. As a consequence, the boilers of the Brazilian ships are larger and heavier for a given power, but there is gain in greater reliability under the conditions of South American service. Reciprocating engines have been adopted and have proved of high efficiency, the radius of action, according to the results of the *Sao Paulo* trials, being 29 percent greater than that guaranteed, or 12,913 nautical miles instead of 10,000 at 10 knots. The full speed on trial—21.623 knots—was realized with 28,645 indicated horsepower, while the guarantee was for 21 knots. On a trial of about four hours' duration, during which six runs were made over the measured mile, a speed of 21¼ knots was attained with 25,517 indicated horsepower. On an eight hours' trial a speed of 20.99 knots was got with 22,355 indicated horsepower. There is thus the important advantage of a reliable high speed as well as a wide radius of action, added to offensive and defensive qualities of a high order, with a draft of only 25 feet, whereas in many of the later foreign dreadnought ships the design is for drafts ranging up to 29 feet and 30 feet. It is obvious that, especially in South American waters, the Brazilian ships must have a great tactical advantage in action. It should be remembered, too, that it is easier to find docking facilities where draft is thus limited.

As has previously been mentioned, the battleships *Minas Geraes* and the *Sao Paulo*, and the scouts *Bahia* and *Rio Grande do Sul* have been built from the designs prepared by Mr. J. R. Perrett, the chief constructor to Sir W. G. Armstrong, Whitworth & Company, Ltd., who also manufactured the armaments. The machinery was, however, manufactured and supplied by Vickers, Sons & Maxim, Ltd., Barrow-in-Furness; and when it is recalled that no two naval construction firms in the world have had an equally large experience in warship design and construction, it will be understood that this association has been to the great advantage of the Republic of Brazil. From first to last the performances of these ships in gun power, in thermo-dynamic, propeller and ship-form efficiency, and in maneuvering qualities have been most satisfactory, and the results must have afforded considerable satisfaction to his excellency Admiral Duarte Huet de Bacellar and the other officers of the Brazilian Naval Commission.

The Development of the Merchant Marine Shipbuilding in Japan.*

BY DR. S. TERANO AND M. YUKAWA

In 1853, when the American fleet, in command of Commodore Perry, appeared off the coast of Japan, the Shogun was surprised by the enormous size of the warships and awakened from the indolent dreams of the past. In 1854 a Russian man-of-war arrived at Shimoda, and was washed ashore by a tidal wave, and the Russians started to build a wooden schooner. This gave the Japanese the first opportunity of observing the construction of a European vessel. The first shipyard was started in Nagasaki in 1857. Dutch engineers and shipwrights were employed, and the machinery was from Holland. In 1861 permission to own large vessels was granted by the general public. The officers and crew for such vessels would be supplied by the government if desired. In 1862 the policy of closing ports to foreign trade was abandoned. In 1876 the site of the Ishikawajima, Tokyo, was leased to a private concern. This was the first private shipyard of modern type in Japan. The superiority of the Western type of vessel soon became thoroughly recognized.

Japan having no iron it was found more convenient to build small coasting vessels of wood; larger ones were all imported. Out of all, about 800 ships, both steamers and sailors, built from 1870 to 1884 were of wood, the maximum size being 500 tons.

The government in 1900 issued a code of regulations for the construction of wooden ships. This had a remarkable effect in improving them. In the early seventies a few iron ships were built, one, the *Asahi Maru,* of 406 tons gross, and this was followed by three others. The first steel vessel, the *Chikugogawa Maru,* 664 tons, was laid down in 1890 in Nagasaki. In 1895 the *Suma Maru,* of 1,592 tons, was launched. She was the largest merchant ship built prior to the "Shipbuilding Encouragement Act," and was the first ship fitted with complete cellular double bottom. In 1883 appliances for repairs were scarce. It was recognized that subsidies should be granted for shipyard extension; but the difficulties were still unsettled when, in 1894, the Japan-China war broke out. The number of merchant ships available for war purposes was very considerable, but the withdrawal of 240,000 tons from the trade of the country threatened serious difficulties. The victorious ending of the war caused the commerce industry of the country to expand enormously. The protection and encouragement of shipbuilding were deemed necessary, and during the ninth session of the Imperial Diet bills for the encouragement of navigation and shipbuilding were passed with overwhelming majorities. The rules for ship construction to accompany the "Encouragement Act" came into force in September, 1896, and were the first Japanese rules for shipbuilding. The law for the encouragement of navigation showed a remarkable result. The number of ships was doubled and the tonnage trebled.

* Abstract of paper read at the Jubilee Meeting of the Institution of Naval Architects.

The first ships built under the "Encouragement Act," the *Iyo Maru* of 727 tons, launched in 1897, and the *Hitachi Maru,* became famous on account of being torpedoed and sunk in the Russian war. Since that time the "Encouragement Act" has gradually increased the ships of Japan. The Russian war, in 1904, resulted in a large number of merchant steamers being again taken up for transport service; in consequence, the shipping trade of Japan was in danger of being actually stopped, and during the war both the government and private yards were so busy with repairs that not much work was done with new construction.

The *Tango Maru,* of 7,400 tons, was launched in 1904. After peace was established, the fever for public enterprise came on, and extensive schemes for the expansion of the fleet were carried out. The passenger service between San Francisco, Japan and China demanded faster and better-equipped ships, and an order was placed for three 20-knot passenger steamers of 13,500 gross tons each with the Mitsu-Bishi Works. These boats were turbine-driven and made an average speed of 20.6 knots. The European service was improved by the addition of six steamers of 8,600 tons each and 16 knots speed. The total amount of subsidies paid has increased year by year, in proportion to the advance of shipbuilding, and the progress of the industry has thus been largely due to the assistance from national funds. The original fishing boats of Japan were junk-built and unseaworthy, but the "Encouragement Act" was amended with the object of improving them, thus enabling the Japanese fishermen to go out in the open sea; but the most noteworthy event in fishing boats is the adoption of oil motors.

The first marine engines built in Japan were constructed in 1861, a geared horizontal non-condensing engine with two cylinders 16 inches in diameter and 15⅞ inches stroke. The first compound was built in 1873, with cylinders 12 inches, 21 inches and 18 inches stroke. Triple-expansion engines were introduced in 1880 by purchase from England, and the first one was built in Japan in 1890 at the Mitsu-Bishi Works. Quadruple expansions were few, the first one being built in 1902. The Kawasaki Dockyard Company, at Kobe, is licensed to build the Curtis marine turbine, and is now constructing some for the Imperial navy.

Up to 1887 only iron boilers were built in the country. The first steel boiler was for the tug *Yugawo Maru,* 206 tons, the pressure being 180 pounds. Watertube boilers have not yet been used in the Japan mercantile service except for the volunteer fleet.

The number of private yards has increased from 66 in 1896 to 213 in 1910; the majority, however, are very small, and only capable of building wooden sailing ships or junks. A few are provided with modern appliances. In the matter of equipment, the principal shipyards are equal to first-class firms in Europe and America.

Ships of over 1,000 gross tons were divided into two types—passenger and non-passenger, which were again sub-divided into four classes—ocean service, home trade, coasting trade and smooth-water service—and the subsidies varied according to the respective classes. The machinery bounty is the same in all classes. The necessity of promoting the iron and steel industry was recognized and the government steel works was established in 1898. It is capable of producing 100,000 tons of steel a year. The cost of production and the selling price, however, leave a good deal to be desired, and the builders still import foreign material. It will take some time before Japan can become self-supporting in the shipbuilding industry.

The Bureau of Navigation reports ninety-three sail and steam vessels of 11,999 gross tons were built in the United States and officially numbered during the month of November, 1911, of which 7 percent were steamships.

Fifty Years' Development in the Mercantile Ship Construction.*

BY S. J. P. THEARLE

In 1857 the *Great Eastern* was built at Millwall by Mr. Scott Russell. She was 679 feet 6 inches long, 82 feet 8 inches by 31 feet 6 inches. Had there been no *Great Eastern* the progress of mercantile shipbuilding in the fifty years of the Institute's existence would have shown gradual development throughout. It is only fitting that an institution which owes its existence largely to the energy, foresight and scientific ardor of Scott Russell should in its fifty-first year bear testimony to the genius of that great man. In the year 1860 the mercantile marine of the United Kingdom consisted of 27,663 vessels, of 4,658,687 tons net register, by far the greater part being of wood. Of the total tonnage in 1860, 25,663 vessels, of 4,204,360 tons net, were propelled by sail, and 2,000 vessels, of 454,327 tons net, were steamers. At the end of December, 1909, the merchant ships consisted of 21,189 vessels of 11,585,878 tons net, or 18,402,201 tons gross register. Of these, 11,797 vessels, measuring 10,284,818 tons net, or 16,994,732 tons gross, were steamers. There were 9,392 sailing vessels, of 1,301,060 tons net, or 1,407,469 tons gross register. It will be seen there were 6,474 more vessels in 1860 than there were in 1909, but the tonnage showed in forty-nine years an increase of 6,927,191 tons. To better realize the expansion which has taken place, the gross in steamer tonnage was from 454,327 tons to 10,284,818 tons, while the reduction in sailing tonnage was from 4,204,360 to 1,301,060 tons. We compute a ton of steamer tonnage as at least equal to 3 tons of sailing tonnage. In point of fact the ratio is even greater than 3 to 1, and is constantly increasing; but taking 3 to 1, the ratio of cargo-carrying capacity in 1909 compared with 1860 is as 32,155,514 to 5,567,341, or almost 6 to 1. The average tonnage of sailing vessels in 1860 was 164 tons and that of steamers 227 tons. The average tonnage of cargo steamers in 1870, 1880, 1890 and 1900 was, respectively, 870, 1,330, 1,500 and 1,900. In 1911 the average tonnage was 2,300. The average gross tonnage in the above years was, respectively, 1,050, 1,580, 2,150 and 3,000. The average gross tonnage of cargo steamers built in 1910 was rather more than 3,000. In 1860 the average length of cargo steamers was under 200; in 1911 it had reached 350 to 400 feet.

Lloyd's Register Rules in 1855 for building made the classification of iron vessels in terms of years. In 1863 "A" symbols were used. In 1867 the designation was by numerals, as "100-A, 95-A," etc. In 1860 the frame of an iron ship was formed of an angle-iron and a reversed angle riveted back to back. Beams were formed of plates with double half-round irons on the lower edge and double angles on the upper edge. With the advance in iron rolling a bulb plate took the place of the double bar or half-round section. The box "keelson," which was inaccessible, gave way to a built-up keelson formed of plates with double angles on the upper and lower edges, and this construction still survives. In 1867 water ballast tanks began to form part of the bottom structure. It was not, however, until 1880 that the cellular double bottom in anything like its present form appeared in the mercantile marine, although something like it had been adopted earlier in the ships of the Royal navy, without, however, the characteristic feature of the margin plate at each bilge, with its frame attachment, which then and now is a peculiar feature of the merchant steamer. In 1889 two of the largest and fastest vessels of the Atlantic passenger trade were constructed without double bottom, with ordinary floor and shaped keelson standing upon them. Gradually it was realized that without outer

* Abstract of paper read at the Jubilee Meeting of the Institute of Naval Architects.

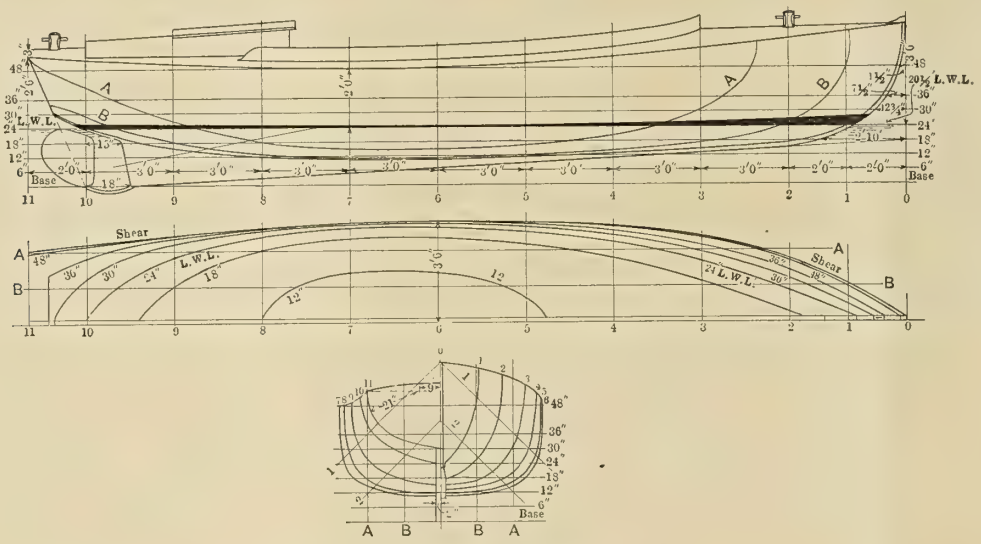
and inner bottom plating, associated with a continuous center girder, continuous margin plates and well-fitted intercostal side girders, there was ample longitudinal strength in the bottom, and the continuous floors associated with intercostal side girders were found to be a more rapid and cheaper construction than any other. The necessity for carrying a certain quantity of water ballast had much to do with fixing the depth of the floor and girders and strength requirements. During the past fifty years bottoms have probably undergone as great a change as any other part of the vessel, and this has specially been the case during recent years.

In regard to recent developments in the structure of merchant vessels, the tendency to omit angle side stringers in holds and to compensate for their omission by increasing the thickness of the shell plating is noticed. Not only does this not detract from the strength of the structure, but it has the advantage of cheaper production, and there is a growing disposition to increase the frame spacing and thickness of shell plating. The joggling of either plate edges or frames is in practice at all ports. In 1860 the pillaring of an iron ship followed the same principle that had been used in vessels of wood, though not being so broad as to require more than a middle line row to the beams clear of the hatchway. As vessels became broader a row of quarter pillars was introduced. The first progressive step in this direction was made when tubular pillars were introduced. Their expense, however, is almost prohibitive. "Massed pillaring" arrangement, in which support to the deck is afforded by a few very strong pillars, came next.

The stiffening of watertight bulkheads has undergone many changes during fifty years. In 1860 the only stiffening to watertight bulkheads consisted of angle-bars spaced about 30 inches apart. Before the bulkhead committee appointed in 1891 sat, the committee of Lloyd's Register had increased the stiffening requirements by making the vertical stiffeners of frame angle size and by fitting horizontal stiffeners. For years after iron ships were built they were fitted with wooden decks. With increased size grew the necessity of providing strength in excess of that which was obtainable through stringers and tie plates, and iron decks were found to be a necessity.

Recent years have witnessed many important departures in steel ship construction. The first to claim attention were the "turret" steamers introduced by Messrs. Doxford & Company. The advantage of the "turret" system is a larger deadweight carrying capacity. The "trunk" steamers were introduced by Messrs. Ropner, and were chiefly used for conveying ore and grain. The cantilever frame wing tank steamers of Messrs. Sir Raylton Dixon & Company followed, and it is regretted that the Institution of Naval Architects has no record of this type of vessel; and this may be said of the McGlashan side-tank steamer. Probably the most interesting of all recent developments in ship design is that of Mr. Isherwood, which involves longitudinal framing. Upward of ninety of these vessels, with an aggregate of 356,000 tons, have been ordered.

To do full justice to the subject of this paper, however, notice should be made of the composite system of construction between 1860 and 1870. This system combines the strength of iron frame work partially plated with the advantage of wooden skin to receive copper sheathing. The performance of the composite tea clippers will long be remembered. The system, however, an expensive one to build, was found liable to special forms of deterioration, chiefly associated with galvanic action.



LINES OF A NEW 30-FOOT FREIGHT LAUNCH

Thirty-Foot Freight Launch.

A 30-foot freight launch has been designed by Tasker & Strawbridge, Philadelphia, for James Murphy & Sons, Placentia, N. F. The boat is 30 feet long over all, with a load waterline length of 26 feet 3½ inches. The extreme beam is 7 feet molded, and the width on the load waterline 6 feet 6 inches molded. The freeboard runs from 3 feet 6 inches at the bow to 2 feet amidships, and 2 feet 6 inches at the stern. The extreme draft is 2 feet.

The keel is constructed of oak 4 inches thick, sided 5 inches, and the framing is of sound white oak 1¼ inches square. White oak is used for the shear strake, which is 1 inch thick, and the planking is of ⅞-inch white pine, copper fastened throughout. The deck beams are 1¼ inches by 3 inches of oak. The decking itself is of quartered white oak, laid fore and aft, blind fastened.

The cockpit is sealed up on the inside with ⅜-inch spruce. The gasoline (petrol) tank and watertight lockers are located under the forward deck. There is a sliding companionway over the motor in the stern, with lockers aft of the motor compartment. The flooring throughout the launch is put down to facilitate the cleaning of bilges. An ordinary steering wheel and drum are provided actuating a bronze or galvanized iron rudder. The gasoline (petrol) tank is of 35 gallons capacity, fitted with two interior bulkheads to prevent swashing of the oil in a seaway. It is proposed to install a 7 to 10-horsepower, medium or heavy duty, high-grade engine for propulsion.

Repair Plant on Board the U. S. Battleship Georgia

Among recent improvements in the equipment of battleships one of the most important is the installation of repair plants, so that a great amount of the repairing can be done on a vessel without recourse to a navy yard, making the vessel in a measure self-supporting. The repair plant of the *Georgia,* which was installed after the vessel was in commission, was described in the August issue of the *Journal of the American Society of Naval Engineers,* of which the following is an abstract:

FIG. 1.—GENERAL VIEW OF FOUNDRY

The foundry is situated on the upper deck, and is in a small deck-house abaft the after funnel. It contains a Mircs combined blacksmith's forge and melting furnace, capable of taking a No. 70 crucible; a bin with one-half ton of Albany sand; several flasks, iron and wood, and other foundry accessories, such as tongs, shanks, clamps, etc. The largest casting made up to date weighed about 175 pounds with riser and gate. Since its installation a year ago the foundry has turned out over 800 castings of all sizes. Oil fuel is used for melting metal. Albany sand is used, as practically none but brass castings are made. Iron castings can be made in emergencies, but the crucibles when melting iron last only a very short time. It has been found that the foundry has been the greatest asset to the repair plant of the ship, since much of the machine work formerly done at a navy yard is now done on board on account of the fact that castings can be made on board.

The blacksmith shop is situated in a small deck-house on the upper deck between the two forward funnels. A large rectangular double forge is installed, capable of handling 4½-inch bars. A small ¼-horsepower portable electric blower furnishes ample blast for both fires. The fires are also used by the coppersmith for large brazing jobs. The small space in the trunk to forced draft blowers is used as a copper shop. All the small work is done here, while the heavier work is done either in the foundry or in the blacksmith shop. This enables most of the copper work to be kept in repair and necessary changes to be made. For the carpenter's shop it was found necessary to use a forward compartment on the port side of the gun-deck. Besides heavy carpenters' benches a speed lathe and circular saw, driven by a 3-horsepower electric motor, are installed. Beside the carpenter's shop is a

FIG. 2.—BLACKSMITH'S SHOP

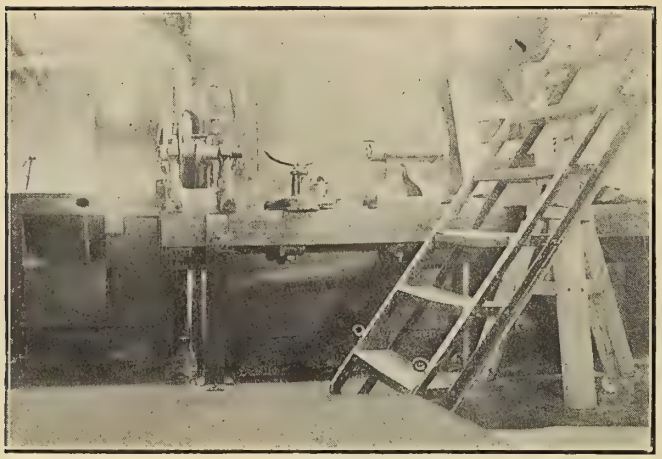


FIG. 5.—CIRCULAR SAW AND SPEED LATHE

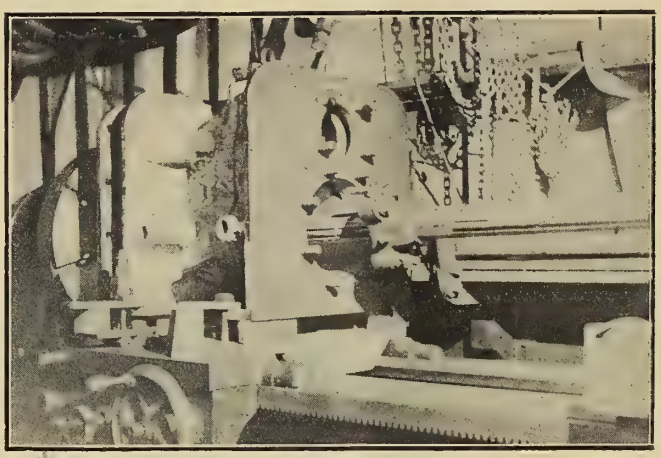


FIG. 6.—BORING 100-K.W. DYNAMO CYLINDER

plumber's shop, the equipment of which consists largely of hand tools.

An important part of the outfit is the machine shop, which is located directly underneath the evaporator room, just abaft the fire-rooms and just forward of the upper engine rooms, or in what is probably the hottest part of the ship. The equipment includes a large gap lathe with 54-inch swing; a 14-inch Flather machine lathe; a 16-inch by 12-foot Hendey-Norton tool-room lathe; a No. 14½ Becker-Brainard universal milling machine with vertical attachment; an 18-inch shaper; a 28-inch drill press with a 12-inch sensitive drill. All these tools with one exception are driven by one large shop motor through belts and countershafts. The Hendey lathe has an independent motor drive, and has been found the most valuable tool in the shop.

The value of such repair equipments on board a ship are evident from the fact that at the first repair period for the *Georgia* the only work to be done in the engineering department by the navy yard was the manufacture of two castings for the ash ejector system and re-bushing the stern bearings. All other work was done by the ship's force on the ship.

DUCHESS OF RICHMOND

Railway Steamer Duchess of Richmond

We present herewith a picture of the paddle-wheel steamer *Duchess of Richmond,* built for the Portsmouth and Isle of Wight service of the London, Brighton & South Coast Railway Company. The vessel was built by Messrs. D. & W. Henderson & Company, Ltd., at their historic yard at Meadowside, Glasgow. She is of a handsome model. Her dimensions are 198 feet by 26 feet by 9 feet molded. She is fitted up with the most up-to-date appliances in every department, including a complete installation of electric light. The accommodation for first class passengers is aft, the drawing-room being on the main deck and the dining saloon on the lower deck. The second class accommodation is forward, and is very comfortable.

The engines are of the compound diagonal type, with cylinders 27 inches and 51 inches diameter and 54 inches stroke. The boiler is double-ended, of the multi-tubular type, working at a pressure of 130 pounds. It is 12 feet 3 inches diameter and 17 feet long, and has four furnaces. All the piping is of copper and Bryce's patent coupling is used wherever possible. The high-pressure cylinder of the main engine has a piston valve, and the low-pressure a slide valve. The pistons are conical in shape, and are fitted with suitably supported packing rings. The guide bars, cross-heads, piston and connectng rods are of forged steel, as is the valve gear. The working parts are of phosphor bronze. The guide shoes and crank-shaft bearings are of cast steel. The guide shoes are white metal, lined, and the shaft bearings have gunmetal bushes. The crank-shaft is of forged steel with couplings at the ends. The two webs and crank pin for each engine are forged together and shrunk on the shaft. The air pump is Edwards' patent, and the circulating pump is centrifugal, supplied by Allen, of Bradford. The surface condenser is of cast iron, and supports the main bearings; it has an ample surface in the tubes, tinned on both sides, which are ¾ inch diameter. The auxiliary machinery consists of a pair of pumps and float tank, by G. & J. Weir, of Glasgow, and a duplex pump by Lamont. The steam reversing gear is that of Messrs. Brown Bros. The propelling machinery operates a pair of feathering paddle-wheels, having eight curved steel floats in each wheel. The steam is supplied at a pressure of 130 pounds per square inch, and on trial the vessel gave a very satisfactory performance.

Preliminary Census Report of United States Shipbuilding

A preliminary statement of the general results of the thirteenth census of establishments engaged in shipbuilding has been issued by Director Durand, of the Bureau of the Census, Department of Commerce and Labor. It includes the operations of shipyards building steel and wooden steam, sail and unrigged vessels; yachts, motor boats, rowboats and canoes; and the manufacture of masts, spars, oars and rigging. The report contains summaries showing the general statistics of private shipyards and of government shipyards separately, and the number, kind and tonnage of all vessels launched in 1904 and 1909. It was prepared under the direction of William M. Steuart, chief statistician for manufactures, Bureau of the Census. The figures are subject to such revision as may be necessary after a further examination of the original reports.

Rates of Increase

The general summary for private shipyards shows increases in six and decreases in five of the items at the census of 1909, as compared with that for 1904.

The number of establishments increased 23 percent; capital invested, 4 percent; number of salaried officials and clerks, 20 percent; amount paid in salaries, 21 percent; miscellaneous expenses, 33 percent; primary horsepower, 13 percent.

The value of work done during the year decreased 11 percent; cost of materials, 17 percent; value added by manufacture, 7 percent; average number of wage-earners employed during the year, 20 percent; amount paid for wages, 14 percent.

There were 1,353 establishments engaged in this industry in 1909 and 1,097 in 1904, an increase of 23 percent.

The capital invested as reported in 1909 was $126,118,000 (£26,000,000), a gain of 4 percent over 1904. The average capital per establishment was approximately $93,000 (£19,000) in 1909 and $111,000 (£22,800) in 1904.

Value of Work Done

The value of work done at private shipyards during the year 1909 was $73,360,000 (£15,000,000), a decrease of 11 percent from 1904. The average per establishment was approximately $54,000 (£11,000) in 1909 and $75,000 (£15,400) in 1904. The decrease in value is due to the dismantling of a large shipyard in Connecticut after the completion of the *Minnesota* and *Dakota;* to a decrease in construction in Pennsylvania, and to a reduction of output in one large establishment in California. The work in the establishments referred to in the last-named States was largely for the government in 1904.

The cost of materials used was $31,214,000 (£6,400,000) in 1909, a decrease of 17 percent since 1904.

The value added by manufacture was $42,146,000 (£9,060,000) in 1909 and $45,306,000 (£9,320,000) in 1904, a decrease of 7 percent. This item formed 57 percent of the total value of products in 1909 and 55 percent in 1904. The value added by manufacture represents the difference between the cost of materials used and the value of products after the manufacturing processes have been expended upon them. It is the best measure of the relative importance of industries.

The miscellaneous expenses amounted to $7,004,000 (£1,440,000) in 1909 and $5,256,000 (£1,080,000) in 1904, an increase of 33 percent.

The salaries and wages amounted to $29,303,000 (£6,025,000) in 1909, a decrease of 10 percent since 1904.

The number of salaried officials and clerks was 2,980 in 1909 and 2,480 in 1904, an increase of 20 percent; their salaries increased from $3,340,000 (£686,000) in 1904 to $4,035,000 (£830,000) in 1909, or 21 percent.

The average number of wage-earners employed during the year was 40,506 in 1909 and 50,754 in 1904, a decrease of 20 percent; their wages decreased from $29,241,000 (£6,000,000) in 1904 to $25,268,000 (£5,200,000) in 1909, or 14 percent.

Government Shipyards

The general summary for government shipyards shows increases in all the items at the census of 1909 as compared with that for 1904.

The value of work done during the year increased 50 percent; cost of materials, 42 percent; value added by manufacture, 55 percent; average number of wage-earners employed during the year, 19 percent; amount paid for wages, 30 percent; number of salaried officials and clerks, 233 percent; amount paid in salaries 279 percent; miscellaneous expenses, 219 percent.

Decrease in Total Number and Tonnage

The statement of kind, number and tonnage is not that of vessels begun or advanced toward launching, but only of vessels launched, which may happen to be less numerous and important during the census year than those on the ways. Fewer ships were launched and the tonnage was less in 1909 than in 1904.

The aggregate number of vessels of all kinds of 5 tons and over launched at private and government shipyards, together with those launched by establishments engaged primarily in the manufacture of foundry and machine-shop products, steam railroad cars and lumber and timber products, was 1,637 of 481,813 gross tons in 1909, compared with 2,279 of 553,599 gross tons in 1904. This is a decrease of 28 percent in number, but of only 13 percent in gross tonnage, the average tonnage per vessel increasing.

Of this aggregate, the number launched at private shipyards of concerns primarily engaged in shipbuilding during 1909 was 1,584, compared with 2,114 in 1904, a decrease of 25 percent. The gross tons totaled 467,219 in 1909 and 504,020 in 1904, a decrease of 7 percent. The net tonnage decreased from 424,708 to 381,198, or 10 percent.

The number launched at government shipyards was 31 both in 1909 and 1904. The gross tonnage was 2,059 in 1909 and 27,252 in 1904, a decrease of 92 percent, indicating that the average vessel launched was very much smaller than in 1904. No battleship was launched from a government shipyard in 1909; the *Florida,* under construction, was not launched until 1910. The battleship *Connecticut* of 16,000 tons displacement and two steel training barks of a combined gross tonnage of 3,600 were launched in 1904. This accounts for most of the great decrease in tonnage at government shipyards.

There were launched in 1909, 22 vessels of 5 tons and over having a gross tonnage of 12,535, and in 1904, 134 with a gross tonnage of 22,327, by establishments engaged in making such articles as steam railroad cars, foundry and machine-shop products and lumber and timber products.

Character of Vessels

The aggregate of steel vessels was 169 in 1909, having 260,765 tons compared with 175 in 1904 having 178,572 gross tons, a decrease of 3 percent in number and an increase of 46 percent in tonnage. The aggregate number of wooden vessels of 5 tons and over launched at all shipyards in 1909 was 1,468 of 221,048 gross tons, compared with 2,104 in 1904 of 375,027 gross tons, a decrease of 30 percent in number and 41 percent in tonnage. Of boats of less than 5 tons the aggregate number in 1909 was 9,042, and in 1904, 3,916, a gain of 131 percent. All these statistics include vessels built by government yards and by concerns not primarily engaged in shipbuilding.

Letters of Interest from Practical Marine Engineers

Incidents Relating to the Design, Care and Handling of Marine Engines, Boilers and Auxiliaries; Breakdowns at Sea and Repairs

Walschaet Valve Gear

The Walschaet or Heusinger von Waldegg valve gear is a type of radial gear which is seldom fitted to marine engines. It is, however, being extensively adopted by the Pennsylvania Railroad and others.

The arrangement of this gear is shown in Fig. 1, and is as follows:

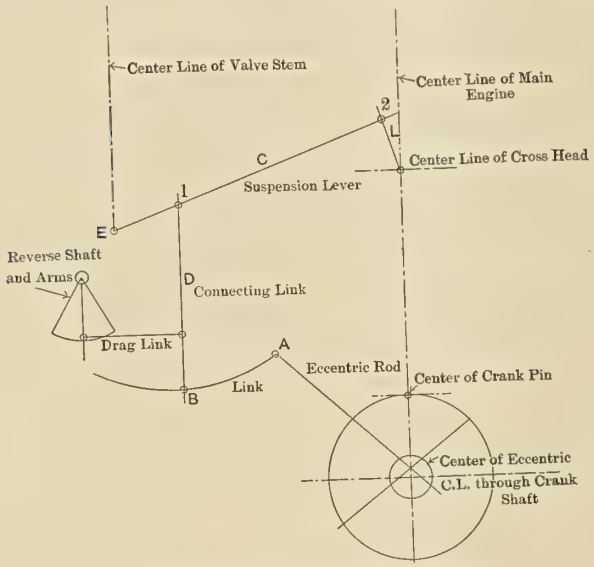


FIG. 1.—SKETCH OF WALSCHAET VALVE GEAR

An eccentric is keyed to the crankshaft at an angle of 90 or 180 degrees. The eccentric rod engages at its end *A* a link, which rotates about the center *B*. The link block connects to the suspension lever *C* by a link *D*. The end of the suspension lever is driven direct from the crosshead of main engine through the medium of links *L*. The valve stem is connected at *E* at other end of suspension lever. The sketch shows arrangement for outside steam. If inside steam, then valve stem is between the points 1 and 2.

The indicator diagrams shown in Fig. 2 were taken from a marine quadruple-expansion engine fitted with this gear. These diagrams were taken some months before the writer was called in on some consultation work, and are very poor specimens. Upon examining these diagrams the first thing that fixes attention is the poorly designed reducing motion, which is very crude, yet it was furnished by the builders of this vessel. The steam distribution is bad, and is due in part to poor proportions of the valve gear. The cut-off is even slower than with the ordinary link motion.

Diagrams of Fig. 2 were taken when the engine was making 138 turns. These diagrams are very interesting, and are remarkable examples of poor design and adjustment of this type of gear. With a properly designed gear and adjustment of valves, and with proper reducing motion, the diagrams will be very different. I do not mean to infer that the diagrams are not correctly taken, but the design throughout in this case is very poor.

Looking now at the diagrams shown in Fig. 3, we see perfect diagrams taken from a locomotive fitted with this type of gear, showing the advantages and serviceability of this type of gear. In a correctly designed arrangement these diagrams are characteristic, and a comparison of these diagrams with those taken from engines fitted with Stephenson's link are worthy of close and careful perusal. CHARLES S. LINCH.

Temporary Repair of an Atlantic Liner's Thrust Shaft

EDITOR INTERNATIONAL MARINE ENGINEERING:

We were on our usual run across the Atlantic, west bound, with about 2,000 sacks of mail, and somewhere over a thou-

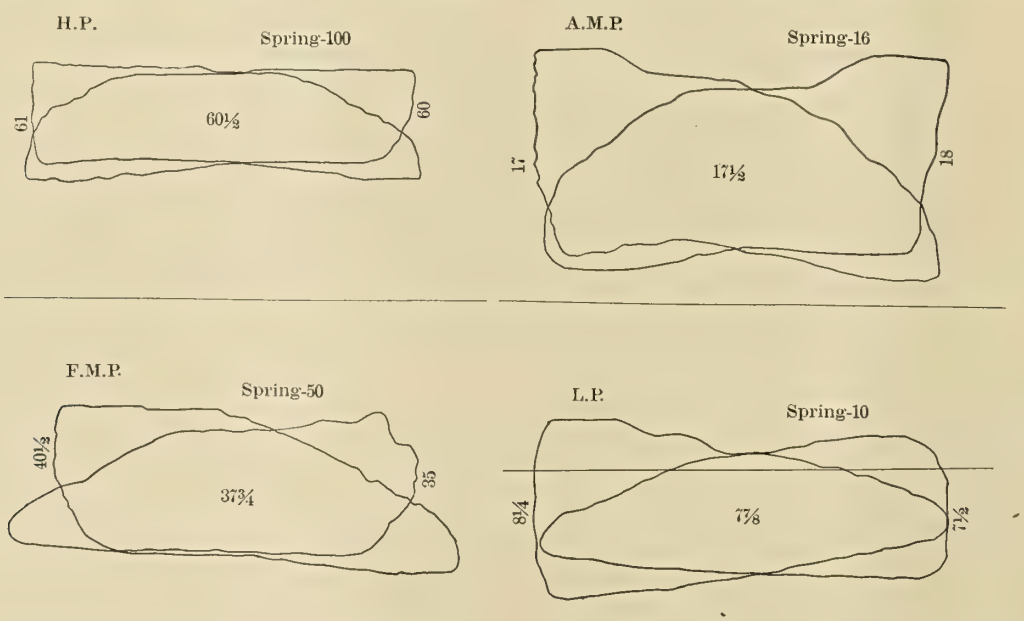


FIG. 2.—INDICATOR CARDS FROM QUADRUPLE-EXPANSION MARINE ENGINE FITTED WITH WALSCHAET VALVE GEAR

sand passengers. As a matter of fact, the accident I am going to write of happened when we were about four and one-half days' run out from Queenstown. It happened on the steamship "U——," and it was while one of the engineers was on watch and noticed that several of the thrust block rings were moving about in an unusual manner that we first began to notice anything was wrong.

A careful watch was set on the thrust block rings, and after some time the movements of the rings not becoming any worse we began to think that matters were not really so bad as we had at first thought them to be. However, shortly after we had eased our minds a bit the ship gave a very sudden and big lurch to port. This didn't seem to improve matters at all around the thrust block, and so after a great deal of wondering what was best to be done we stopped the engines, and it was then, on making an examination of the shaft, that we found it was broken.

We found a fracture extending along the neck close to a collar for three-quarters way round the circumference, then diagonally fore and aft to the next collar, and then back round the circumference for a short distance in the opposite direction. Adjoining each collar we found the cracks opened very much. At this time the ship was about one and one-half to two days' ordinary steaming from New York, the port for which we were bound. We decided that, as we were only such a distance from port, and as the weather was good, that we would effect only a temporary repair, and then proceed under easy steam to port.

The repairs were made in the following manner: In order to bind the shaft together endways, three holes were drilled in each of the collars next to the fracture, and then we put coupling bolts through them and drew them up as tight as we could. We next passed a strong clamp round the body of the shaft between the collars, and around the neck and the collars two straps were passed to secure the whole. We decided to guard against the shaft falling should the repairs give out. We supported the end of the shaft next the fracture from the deckbeams by a chain sling and stretching screws, the shaft revolving in the bight of the sling. The repairs took us four and one-half days to complete, and we then made a start under easy steam; but, after working for four and one-half hours, we had the misfortune to break one of the bolts.

We had now to stop the engines again and start in and repair this broken bolt, and, I might say, this job took us twenty hours' hard work. This completed, we started up the engines again at a nine-knot gait; at this speed the repairs showed no weakness, so we increased the speed to twelve knots, which enabled the ship to reach New York about six days late. It is needless to say we had a new shaft in New York.

F. J. S. N.

Camden, N. J.

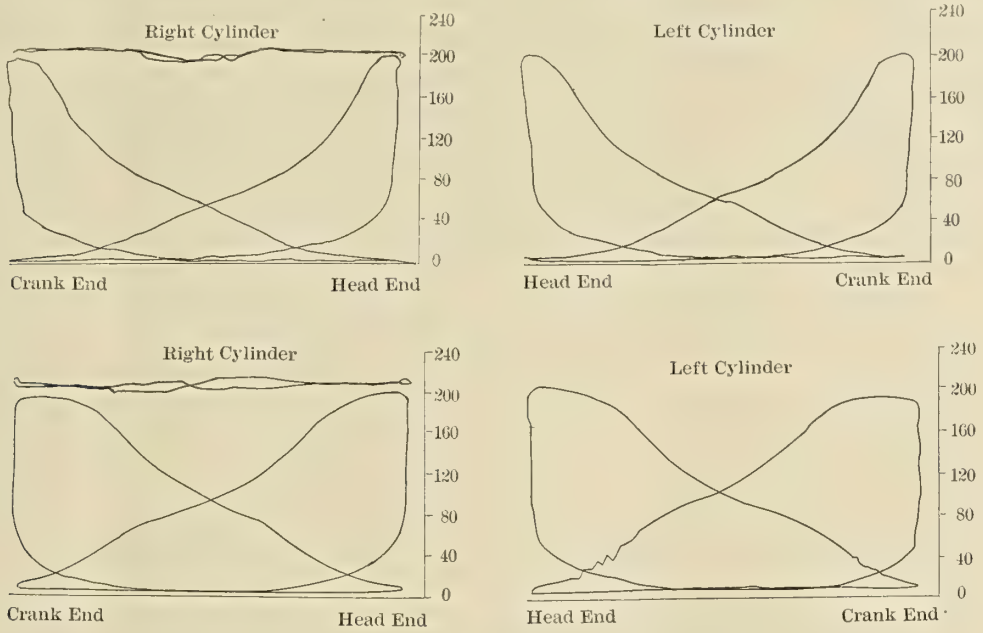


FIG. 3.—PERFECT INDICATOR DIAGRAMS FROM LOCOMOTIVE EQUIPPED WITH WALSCHAET VALVE GEAR

A Series of Accidents

It has sometimes been said that sea-going men are superstitious. The best answer to that is probably that even the matter-of-fact individuals in comfortable offices who suffer the smile of scorn at the mariner to irradiate their features, would possibly develop a touch of imagination—or nerves—if they were put face to face with some of the more exciting episodes of a seagoing engineer's life. It is very easy almost to believe in the personality of machinery at times when the engines are doing battle with the elements, and also when everything on board seems to be "going wrong."

It was not, however, with the object of developing a new theology that this article was commenced, but rather to describe a series of engineering incidents which can be classed as extraordinary. Some years ago a tramp steamer was making a run between Gibraltar and Malta in rather rough weather. A few hours out it was noticed that the engine speed slowed down from about seventy-five to fifty revolutions, although valves were full open and full steam was carried. There was no external trouble to account for this, but a dull thudding was heard in the engine. This was located in the low presure line, and by listening at the cylinder the thudding and clicking could be distinctly heard.

A repair at sea was out of the question in such heavy weather, so that it was decided to run on to Gibraltar, and the number of times that the engineer on watch placed his ear against that low-pressure cylinder was remarkable. Nothing startling occurred, however, till harbor was reached and the order came from the bridge to go half-speed. No sooner had the engines been slowed down than it seemed as if they would push their way through the bottom of the boat. The noise in the cylinder was that of a power hammer, and everybody stood ready to jump. The engineers held to it, however, but when the order came to stop the engines for a moment

to let another craft pass, it was impossible to start again and the anchor had to be dropped right there.

When the low-pressure cylinder cover was lifted the pleasing fact was discovered that the piston had broken clean in halves, as shown in the sketch, Fig. 1. The way in which the two halves kept together was almost a miracle; it was probably due partly to the fact that the piston was a deep one, partly because the crack across the top web was at an angle to the

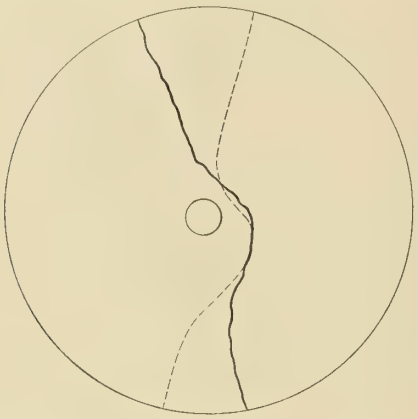


FIG. 1

fracture in the lower web, and partly also because the piston rings acted to some extent as straps. The engineers had a little quiet reflection, however, on the number of times their ears had been in close proximity to danger during the voyage.

As there were means of repair, none too extensive, at Gibraltar, the owners of the boat were wired as to whether they would allow the boat to lie up till a new piston rod could be dispatched from Great Britain, or whether a repair should be attempted on site. The reply was to the effect that too much delay would be caused by getting the repair from home, and that Gibraltar had better do its best.

A new piston head was therefore cast and machined from the old one, and duly delivered on board. The fit appeared to be good, but almost as an afterthought, and just as the cylinder cover was about to be tightened down, the chief engineer decided to have the engine barred round. The curious result was obtained that, on the top of its stroke, the piston lifted the cylinder cover 3/8 inch off the flange at the joint, and on examination it was found that the coning of the hole had

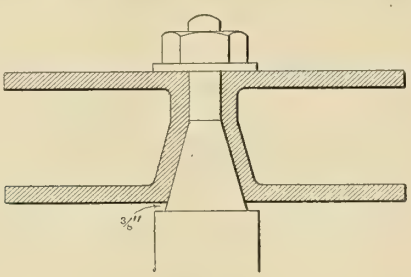


FIG. 2

not been sufficiently deep, so that the piston did not come down to its solid position by 3/8 inch, as seen in Fig. 2. An informal vote of thanks was given by the chief engineer to himself for having thought of barring the engine round, and pious hopes concerning the future welfare of the foundry people on shore were expressed.

The coned hole was cleaned out so that the piston was let down another 3/8 inch, and as this left no clearance between the head of the piston and the top of the cylinder, and as the metal at the top of the piston head was amply designed, a further depth of 3/8 inch was turned off the piston head. As a further precaution, a piece of thick lead sheeting was interposed between the top flange of the cylinder casting and the corresponding flange of the cover.

It must be remembered that all this time the boat was urgently wanted, but the various repairs had taken up a period of three weeks. The last part of the performance was finished at high pressure, and after the engine had been first barred round, and afterwards turned over slowly by steam, the chief engineer gave all hands half-an-hour for tea before setting the engines away for the trip. The engine had turned over quite easily, and everything at last seemed in order. When tea was over, however, and an attempt at a start was made, the engine would not budge. It took the united efforts of the engine room crowd and the steam starting engine to get her over a turn or two. Then, just when it seemed necessary to pull everything down and start a general overhaul, the engine gave a jerk and then went ahead quite smoothly.

The inner meaning of this last phenomenon was not discovered until the vessel had been some hours on her voyage. It was then found that the boilers were gaining water very rapidly, and a test with the salinometer showed that salt water was getting in very freely. The boat was therefore stopped and the condensers opened out. It was then found that a considerable number of the wooden ferrules which should hold the tubes in the tube plates had disappeared, and a lot more were loose. The three weeks' rest in the hot climate of Gibraltar had dried them and shrunk them up, so that at the resumption of work they dropped out and opened up practically free communication between the steam and the water. As the weather was calm, the boat was kept stopped until fresh ferrules had been put in, after which the boat ran perfectly normal. This, however, explained the bad starting of the engine. Both the auxiliary barring engine and the main engine exhaust passed to the condenser, and, in barring over the main engine (and still more when steam was opened up onto the main engine itself for the purpose of turning over slowly) a vaccum was formed in the condenser, drawing seawater into the steam space. When the engine was shut down for the half-hour tea time, this water gradually drew up into the cylinder of the barring engine and also the low pressure cylinder of the main engine. It was not until all this water had been cleared out by hard work that the engine was free to run.

This experience, viewed retrospectively, has its humorous side, but it would probably be hard to beat it as a succession of mechanical failures treading so closely on each other's heels.—*American Marine Engineer.*

Economy from the Stokehold

EDITOR INTERNATIONAL MARINE ENGINEERING:

There is at present quite a discussion as to the relative merits of the reciprocating engine versus turbine. The writer frankly admits that not enough scientific consideration is given to the design of the multiple cylinder engine, while the turbine is of necessity a machine where thermodynamic principles must be studied. There is one thing in designing an engine where every refinement may be introduced, and refined tests made, after same has been built and installed, but it is up to the engineer of the ship to so work his plant that the same or even greater economy may result. The most important thing, however, is the boiler plant. It is only a waste of time to point out what is evident to many sea-going engineers, viz., poorly designed pipe plans, etc. In any argument there is one thing that must be borne in mind: the designer may design for certain results and the design may be good, but when the plant is put into the hands of the engineering force aboard ship, it is up to them to show results.

To illustrate my assertions: One day, coming out of Sa-

vannah, on the steamer "R——," I was leaning against the rail looking up at the smoke pouring out of the funnel and thinking about the waste that was going on. My watch below did not begin for one hour later. While soliloquizing in this way, along came the head fireman on my watch, and I said to him:

"B——, I will give you a dollar and the other two on your watch one dollar each if we run to a certain point and no smoke shows at the funnel."

His reply to this was:

"I will do it."

I posted two or three of the watch on deck to note conditions, and from time to time came on deck to look for myself. There was at times the slightest trace of smoke. I do not mean to say that it was entirely eliminated, but it was simply a trace.

They won, and so did I, for they convinced me then and there that there is a way, and only one way, to fire—that is, fire often and light, which I compelled them to do. Keep a thin live fire, not a great thick one which is only alive on top. Firemen like to fill up the furnace—and likewise their pipes.

Now of what use in seeking refinements of design when no attention is paid to the fire room? Is it fair to argue on the relative merits of different types of prime movers when no attention is paid to the source of power? It is up to the sea-going engineer to show economy after it has been proved by the designing engineers that certain results can be obtained, and it would pay many designing engineers to listen to the sea-going engineers and work together to get the best from actual experience. I again reiterate that greater economy can be obtained if the engineer on watch compelled his firemen to fire properly.

The evaporation of water and the pounds evaporated is quoted by some as a criterion of the firemen's efficiency, and it is, they say, very high. Yes, it is high, and the water disappears, but go into the engine room and see it streaming down the valve stems and piston rods. A calorimeter is an unknown quantity, so is the dryness factor of the steam. Separators on main steam lines are frequently conspicuous by their absence, and this condition is permitted to exist.

The above illustration of the ability of firemen to produce results resulted in this case in an enormous saving in fuel, and they had sold themselves for one dollar. Let us have more intelligence in the fire room, and perhaps we can show even greater economy for any prime mover. Let the designing engineer introduce refinements in design, not go plodding along in the same old rut. I admit that they are to a certain extent forced to do certain things to cheapen construction, and the object of the builders is to build and get the product off their hands; but I contend there is far greater economy in the reciprocating engine than now obtains on many of our ships, partly in design, and partly to handling in every-day practice, and it is in great part up to the operating engineers to get it out of them. Why is it that when running a test the performance of a ship is higher in many cases than when in every-day running? I have found it to be due to an intelligent method of firing. I could enumerate many cases and submit data proving this, but it would only prove what has been said. I do not purpose going into an argument as to the relative merits of turbine over reciprocating engines, because it is not necessary, but in any case the performance of both can be improved, and that by the engineers in charge of the plant.

CHARLES S. LINCH.

Explosion of a Watertube Boiler.

EDITOR INTERNATIONAL MARINE ENGINEERING:

The explosion I am about to write of took place on board a side-wheel steamer. The boiler was of the Haythorne watertube type. It has 270 tubes arranged in nine sections or elements, each section containing fifteen tubes in height and two in width; the length of the tubes varying from 9 feet 1 inch in the bottom rows to 14 feet 3 inches in the top or outer rows. The tubes forming the bottom, middle and outer rows are 3⅛ inch in diameter, reduced to 2 inches in diameter at either end, and varying in thickness, according to their position, from .212 inch to .160 inch, the row next the fire being the thickest. The remaining tubes are 2 inches in diameter, and vary according to their position from .160 inch to .128 inch in thickness.

The whole of the tubes are of solid drawn steel, manufactured by the Mannesmann process, and are connected to the headers by means of brass ferrules screwed twelve threads per inch on the outside and sixteen threads per inch on the inside. The headers are made of malleable cast iron, each front one having a diaphragm at its upper end, so as to allow of the back rows of tubes acting as down-comers, while the remainder act as up-comers. A brass saddle casting, having a central division throughout its length to suit the up-and-down-comer arrangement, is riveted to the bottom of the steam drum, and each of the front headers is attached to this casting by means of four 1-inch bolts.

A screwed ferrule connecting one of the bottom tubes to the front header was forced out of its socket, which allowed the tube to come out of its place sufficiently far enough to permit of the contents of the boiler escaping between the end of the tube and the face of the header. The steam pressure in the boiler when this occurred being 200 pounds per square inch. This explosion resulted from the failure of the screwed threads of one of the ferrules by which the tubes are connected to the headers. The ferrules are screwed on the inside and outside with threads of different pitch, and although the arrangement no doubt allows the cone ends of the tubes to be forced very tightly into the headers, and unless the greatest care is taken in the operation, the strain on the threads is likely to be excessive and more than sufficient to cause them to be damaged. The use of the rubber washers I have referred to have not, so far as I am aware, the good opinion of many marine engineers. Exception has also been taken to the fineness of the screwed threads on the ferrules. The steam and water drum is 3 feet 6 inches diameter and 6 feet 3 inches in length. The dished ends are 1⅛ inches thick, stayed by means of four through stays, 2¾ inches diameter. The boiler is fitted with the usual mountings, the safety valve being loaded to 200 pounds per square inch.

Camden, N. J. F. J. S. N.

The annual report of the Secretary of the United States navy makes a recommendation to Congress for an allowance for commanders-in-chief of fleets for purposes of official entertainment. This recommendation is one that should receive most hearty support on the part of law makers, for the best way to keep up the friendliness of one navy with another is that of proper entertainment, and with the limited incomes that navy officers have, and especially the necessity of those who are married maintaining homes on shore as well as contributing to the mess on his own ship, makes a great drain upon their resources. It is only ordinary justice that it should be left to the discretion of the commander-in-chief to make proper use of an allowance that is at his disposal for this specific purpose.

A record in shiploading was made in Baltimore, Nov. 23, at the Curtis Bay coal pier of the Baltimore & Ohio Railroad. The collier *Newton*, owned by the Federal Coal & Coke Company, was loaded with 7,029 tons of cargo coal and 545 tons of bunker coal in 4 hours and 35 minutes.

Review of Marine Articles in the Engineering Press

SHIPS

Two New Allan Liners.—Orders have recently been placed with Messrs. William Beardmore & Company, Ltd., and the Fairfield Shipbuilding & Engineering Company, Ltd., for the building of two fast passenger and freight ships for the Canadian service. These new vessels will be the largest and fastest ships on this route. Although the speed expected is 20 knots, all has not been sacrificed in the design to power, for the passenger capacity is 200 first class, 500 second class and 3,000 third class, all in staterooms, besides 3,000 tons deadweight of cargo. Special attention is paid to passenger accommodations, with the result that unusual features for this service have been introduced. The vessel will be propelled by Parsons turbines, driving four shafts, with a total shaft-horsepower of 19,000. There will be six double-ended and four single-ended boilers, worked under Howden's forced draft system and arranged for burning oil or coal. Features of the hull design are Frahm anti-rolling tanks and a stern designed on the lines of a cruiser. This enables the steering gear to be placed beneath the waterline. The vessels are classed under the rules of the British Corporation for the Survey and Registry of Shipping. 800 words.—*Engineering,* November 3.

French Submarine Salvage Boat.—A craft of very unusual design intended for the salvage of wrecked submarines of the French navy. The hull is in two separate parts aft though joined forward and coming to the same stem. A strong bridge structure covers and joins the separate parts aft. The space between the two is large enough to contain the largest submersible built or building for the French navy. The vessel will carry electrically-operated lifting apparatus, but will not be self-propelling. As the form and size of the ship make its handling by tugs in high wind or rough weather a very questionable operation its performance is watched with much interest. The length over all is 328 feet and breadth 83 feet 11 inches, draft in light trim 4 feet 7 inches. Launched on September 22 by the "Ateliers et Chantiers de la Loire," of St. Nazaire. Article illustrated. 360 words.—*The Engineer,* November 3.

Turbine-Driven Steamer Newhaven.—The latest addition to the cross-channel fleet between Dieppe and Newhaven, the *Newhaven,* was built by the Société Anonyme des Forges et Chantiers de la Méditerranée at their Havre works. The principal dimensions are: Length over all, 302 feet; breadth, 34 feet 7 inches; depth, 22 feet 2 inches; draft, 9 feet 8 inches. The hull is divided into eight compartments by seven watertight bulkheads extending up to the main deck. Accommodations are provided for 1,000 passengers. Propelling machinery consists of Parsons turbines driving triple screws. The turbine rotors and shafting are of Siemens-Martin steel. Stern tubes and propeller shaft supports are steel castings, while the propellers are of Stone's bronze. The bearings are water-cooled. Steam is supplied by eight Belleville boilers, at a working pressure of 250 pounds per square inch. The total grate surface is 646 square feet, and total heating surface is 17,100 square feet. Forced draft of the closed stokehold system is used. Air is supplied by four fans driven by vertical engines.

There are two condensers, each having 4,220 square feet of cooling surface and connected to a centrifugal circulating pump of a capacity of 385,000 gallons per hour. Each condenser has separate air pump which can draw from either condenser. Full-speed trial gave a speed of 24 knots, at which there was no vibration except astern where the screws throw the water against the hull. At 12 knots, ship can be brought to a dead-stop in thirty seconds over a length of less than 300 feet. 1,100 words.—*Engineering,* November 10.

New Cross-Channel Steamers for the South Eastern & Chatham Railway.—The new turbine steamers *Riviera* and *Engadine,* built by the William Denny & Bros., of Dumbarton, for the cross-Channel service, are very much like the vessels already on these routes, except that they are a little larger, being 315 feet in length, 41 feet molded breadth, and 24 feet 6 inches in depth from the awning deck. The ships are driven by Parson turbines turning triple screws, and steam is supplied by six Babcock & Wilcox boilers, with a seventh in reserve, to provide for one being always off duty for cleaning. On trial the *Riviera* maintained a speed of 21.99 knots for four hours on four boilers, and made a highest mean speed for one hour of 23.07 knots. The passenger accommodations of the vessels are quite similar to other vessels of this class. 600 words.—*The Engineer,* November 17.

The World's Largest Bulk Freighter.—There was recently completed at the Ecorse yard of the Great Lakes Engineering Company the bulk freighter *Col. James M. Schoonmaker,* of the Shenango Steamship Company's fleet. Its dimensions are: Length over all, 617 feet; beam, 64 feet, and depth, 34. This is 6 feet more beam than is usual for the 600-foot type of lake freighter, but as the vessel handles very easy the change is considered a success. The hull is of the arch girder construction, the hold being divided into three compartments. The hoppers at the sides form sloping sides for the cargo unloaders, easy working, and water ballast tanks, in addition to those in the double bottom, giving a total capacity for water ballast of 8,000 tons. There are 35 hatches, 54 feet wide and 9 feet fore and aft. The maiden cargo of 10,799 tons of ore was unloaded in 5 hours and 9 minutes net time. There are accommodations for a limited number of passengers, and special attention has been given to providing everything for their comfort that could be devised. The latest designs in cabin furnishings and furniture were installed and particular pains taken with the sanitary system. Every stateroom has its private bath and shower with the best of plumbing and fixtures. The propelling machinery consists of one quadruple-expansion engine, with cylinders 23, 33¼, 48 and 69 inches by 42 inches stroke. Steam is furnished at 220 pounds working pressure by three Scotch boilers, 14 feet 9 inches diameter by 12 feet 2 inches long, each containing three 44-inch furnaces. The arrangement of the cylinders places the high-pressure forward, the low coming next, the second intermediate and the first intermediate in the order named. The high and intermediate cylinders are fitted with piston valves, the low with a triple-ported slide valve. All are operated by Stevenson link gears, but the second intermediate and low gears being operated by a single rocker arm. Air pump is worked from low-pressure cross-head. Metallic packing is used throughout. A very complete set of auxiliaries are installed, doing all work and furnishing all the service that could possibly be done by machinery. The article is well illustrated by numerous photographs. 3,300 words.—*The Marine Review,* November.

NAVAL ARCHITECTURE

The Residuary Resistance of Vessels.—By Ernest Saxton White, B. S. Read before the North East Coast Institution of Engineers and Shipbuilders. An investigation into the resistance of vessels caused by wave making and eddy taken from a large number of trials and analyzed with the purpose of obtaining an exponent for the term V (speed) in a formula

whereby residuary resistance might be calculated. Although founded on no scientific basis, the results are very interesting and particularly constant. Laying aside the computation of the resistance due to skin friction, which is obtained in the usual well-known manner, the author proposes three factors which govern the residuary resistance: 1. Relation of beam to draft. 2. 'Midship section area coefficient. 3. The form of the ends, the product of which he makes equal K. The value of the third factor is the end coefficient multiplied by the number of beams in the length. If V is speed in knots, x the exponent of this speed, then this coefficient K times V^x equals the residuary power necessary to overcome the residuary resistance. From the analysis of trials made this x is found to equal 2.7 with surprising regularity. No claim is made that this should be so invariably, but the author suggests that designers try the method with the data at hand and check both the method and the value of the exponent. 1,500 words. —*Engineering,* November 3.

The Development of the Holland Submarine Boat.—A lengthy illustrated article containing a complete review of the Holland submarine boat from the first boat built, the *Holland,* to the latest special type design of the present time, followed by special consideration of such topics as provisions for safety, submergence tests and strength, diving mechanism, interior arrangements and stability conditions. The improvement in submarines within the last twelve years may be known from a comparison of the *Holland,* built in 1898, and the latest type now under construction and completed. The former was about 70 tons displacement submerged, with a surface speed of 6 knots and submerged speed of 5 knots. Although exact data of the latest vessels are not given, it is said that they will be between 400 and 500 tons displacement when submerged, with a surface speed of 14 knots and a speed submerged of about 11 knots. They are twin-screw vessels with heavy oil engines and have four bow-torpedo tubes. Vessels of the latest type completed are considered structurally strong enough to withstand pressure at a depth of 250 feet, and are actually tested to a depth of 200 feet. This test is made without a crew, and is regarded as a final precaution against hidden weakness. Holland submarines dive at an angle of not over 2½ degrees except in emergencies. Their hull design is such that the metacentric height increases when the vessel is submerged. This insures sufficient stability for safety in all submerged operations. The article is well illustrated with photographs of vessel diving and interior views and diagrams of stability conditions. 8,500 words.—*Engineering,* November 17.

MARINE ENGINEERING

Crude Oil Marine Engines.—By James H. Rosenthal. Read at British Association for the Advancement of Science, at Portsmouth. A lengthy article giving in descriptions, figures and numerous illustrations the actual state of development of oil engines used for marine work. The author first discusses the general problem of the oil engine designed for large powers, which he stated to be the creation of engines of large power to work as simply on cheap crude oil as the present small motors work on high-priced oils. The great desirability for this is not the saving in fuel cost, for this is small, but in the saving of space, crew's wages and convenience in fuel handling and storage. Follows then a description of the Bolinder engine, which has been fitted to some extent on fishing vessels and barges. The engine does not work on the Diesel principle, but has a heating chamber, which is the source of the ignition. These engines are not hard to operate, and are easily within the ability of some member of a fishing crew. The rest of the paper deals with larger engines operated on the Diesel cycle, both single-acting and double-acting, and describes in some detail the types that have been built and the boats on which they were installed. First used for submarines they were later used in a variety of types; for the propelling power of navy pinnaces they have gone to Argentine, and have also been used as auxiliary power on a large French sailing ship. The reversible double-acting engine is about to be tried on a commercial scale by the Hamburg-American Line in a vessel now being built by Messrs. Blohm-Voss. Toward the last the author describes the mechanical details of both single and double-acting types of the Nurnberg or Diesel cycle engine. 6,600 words.—*The Marine Review,* November.

The Efficiency of the Gas Turbine.—An editorial consideration of this important question, in particular reference to the article reveiewed above. The author calls attention to the fact that no definite statement is made by Mr. Holzwarth as to actual fuel consumption per kilowatt-hour, which he says is an omission, from which our readers will draw their own conclusions. There are given diagrams of efficiency curves, but their precise meaning is a matter of doubt. If it may be correctly inferred that this efficiency is the over-all efficiency from area of indicator diagram to actual output of work the figure is only a fraction of what may be expected from a good reciprocating gas engine. Mr. Holzwarth claims for his turbine an efficiency of 58 percent; from this the over-all efficiency referred to above works out 11.2 percent. With good gas engines values as high as 36 percent have been registered. In experiments in France results more discouraging have been obtained. In an attempt to use turbines to drive torpedoes, where the compressor difficulty does not exist, since either engine or turbine has to have a supply of compressed air, the results of repeated trial were decidedly inferior to that obtained by the present reciprocating engines. 1,600 words.—*Engineering,* November 24.

The Marine Speed-Reduction Gear as a Commercial Proposition.—Heretofore the speed-reduction gear has been considered primarily from an engineering standpoint and investigated largely with the view of whether or not it would work. This article is an editorial consideration of the objections to the various devices which have been introduced from the business point of view. In doing this the author has taken three types of ships for discussion—the fast passenger liner, the intermediate and tramp steamer and the warship. As an example of the first the *Mauretania* is chosen. Any saving of space or power due to the use of a reduction gear might be used to increase speed, decrease fuel consumption, increase radius of action, or increase carrying capacity of the ship. In this case, any increase of speed due to a small increment of power would be scarcely appreciable; the vessel is designed for a certain run, hence radius of action need not be increased; she is a passenger ship, and already has accommodation for the small amount of freight carried; the space saved is in the boiler and engine rooms, and hence not available for passengers. The only direction left that would be benefited would be in the saving of fuel, and this the author shows would be a small percentage, about one-half of 1 percent of the passenger receipts alone. As for the intermediate type and tramp the application here is limited, because the reciprocating engine still holds sway. In future there is a possibility that a small saving in fuel may tempt builders and owners to make the change. In warships the problem is not of so great importance economically. There the question is one largely of expediency and simplicity of design. As it is now with reduction gears there are many unsolved questions which increase the uncertainties to be considered. 3,300 words. —*The Engineer,* November 17.

The Junkers Marine Oil Engine.—Engines of this type are being installed in a new freighter for the Hamburg-American Line building at the works of the Weser Company, of Bremen.

Besides being one of the earliest planned installations of oil engines of any size for marine work it is of unusual design. The engine burns heavy oil fuel in much the manner of a Diesel engine. Each cylinder, however, contains two pistons working in opposite directions, and connected to cranks on the same shaft at 180 degrees with reference to each other. Each cylinder works on the two-cycle principle, but by arranging them in tandem double action is obtained. Since the pistons themselves open and close the cylinder ports, valve gear and scavenging valves are done away with, as well as cylinder covers and stuffing-boxes. Satisfactory tests were run on an experimental engine of 200 horsepower, built by Professor Junkers, from which the data for the present engines were obtained. Later a 1,000-horsepower horizontal stationary engine was built. The article is well illustrated by plates and diagrams of the cycle, description of which is too complicated for satisfactory treatment in a review of this length. 1,200 words.—*Engineering,* November 24.

The Gas Turbine.—By H. Holzwarth. An abbreviated translation of a paper read in German before a meeting of the Schiffbautechnische Gesellschaft held in Berlin November 23 to 25. A brief and none too satisfactory account of a gas turbine built for the author by the Messrs. Korting, A.-G., Hanover. The machine consists essentially of a number of explosion chambers in which charges of air and gas unite, and are exploded at proper intervals, over which is suspended on a vertical shaft a turbine wheel and above it a generator. The whole is enclosed in a casing, which holds the valves opening into the explosion chambers and supports the shaft bearings, governor gear and scavenging apparatus. Inlet valves allow the air and gas to enter the chamber one after the other. Upon being ignited the greatly increased pressure causes a nozzle valve to open, and the available energy in the gas is transformed into kinetic energy, which is transformed into work by passing through and acting upon the turbine wheel. Low initial pressure is used, and this is augmented by a vacuum in the exhaust. The turbine works usually with suction producer gas of 1,100 to 1,200 calories per cubic meter, and has been designed for 1,000 horsepower at 3,000 revolutions per minute. Smooth running has been obtained at all speeds, although a temperature of 500 degrees C. was reached in the turbine casing. Complete scavenging is necessary to prevent it going even higher. It is claimed that the area of this engine's floor space is to that of usual gas-reciprocating engines as 1 is to 3.28; the total weight as 1 is to 4.2. The gas turbine, like the steam turbine, works without shock and vibration and saves the expense of cylinder lubrication. Lubrication of moving parts is thorough and reliable, since all movable parts are in oil baths. With the article is a drawing of the turbine, and diagrams showing efficiency curves for different charges and the normal indicator diagrams for the explosion chambers. 1,700 words.—*Engineering,* November 24.

Miscellaneous

Johnson's Direct-Reading Torsion Meter.—The co-inventor of the well-known Denny & Johnson torsion meter has carried his investigations farther in the same direction, resulting in a direct reading torsion meter whereby one observer can read simultaneously the torsion in one or more shafts by merely glancing at as many dials. The new device is made exclusively by Messrs. Kelvin & James White, Ltd., of Glasgow, and is arranged so that the torsion in the shaft is proportional directly to the resistance of a current passing through a contact piece of high resistance, the same being measured by a voltmeter, which reads directly in terms of torque. From this the usual method is used for obtaining shaft-horsepower. The advantages of this instrument are its adaptability to stationary as well as marine engine shafts, its freedom from error arising from distortion of hulls, as frequently occurs in destroyers and other light high-powered vessels, and in the great advantage of placing the indicating board in any part of the vessel. The article is well illustrated by photographs and drawings. 1,600 words.—*Engineering,* November 3.

Submarines and War Tactics.—An editorial commenting upon the effect of a fleet of submarines in the Turco-Italian war, if used to good advantage, shows how the development of the submarine has raised it from use as a moral effect to a serious factor as an effective fighting unit; reviews the tactical value of the vessels of the present day, and states the strength of the first naval powers in this branch of the service, together with the national policies of each. The editors consider that owing to an agreement with the builders whereby the British government placed all orders with the same firm, and this company gave the government exclusive benefit of all experiments and experience in developing the type, that they have at present the most efficient type of submarine yet brought out. 1,500 words.—*Engineering,* November 17.

The Thermo-Feed Automatic Water Regulator.—A device to keep water level in boilers very nearly constant. Consists of a float in a chamber open to steam space and water space of the boiler, and so adjusted that when water level is higher than that wanted float closes a spring-pressed feed check, which is normally open. The difference between this and the usual type being that it operates directly from the boiler and not from filter box, as is often the case. 750 words and sketch.—*The Marine Engineer and Naval Architect,* October.

The Steam Engine Indicator.—Its History and Application. Prize Essay of the Institute of Marine Engineers, by J. D. Boyle. An account of the development of this important instrument from the days of James Watt to the present, and a description of the best-known makes in use now. Shows how the changes in engine design called for improvements in indicators and how they were met. 2,500 words.—*The Marine Engineer and Naval Architect,* October.

Acetylene Welding and Cutting Machine.—Describes the Davis-Bournonville type of apparatus and describes method of using machine to weld sheet metals together and as used in cutting metals by melting the plates on the line of separation. This is accomplished by means of an oxygen-acetylene gas flame of 6,000 degrees F. temperature, which is run along the line at a speed of about a foot a minute. Preheating the metal to be cut by less expensive flames have been tried and found to be an improvement; 1,200 words.—*The Marine Review,* September.

Canal Traffic Motor Barge.—An experimental craft built by a London company to test the feasibility of developing traffic between London and the provincial towns. Of 71 feet 6 inches length, 7 feet beam and 3 feet 6 inches draft with 30 tons load. The barge can tow another, similarly loaded, and can pass through practically all the canals of England. The engine is a 10-horsepower Brooke kerosene (paraffin) motor, which works on the Otto principle. The reversing gear is a simple clutch. Oil pump is worked off a cam. 700 words and photographs of engine, clutch and loaded barge.—*The Marine Engineer and Naval Architect,* October.

The New York Shipbuilding Company, Camden, N. J., has installed a new type of crane at its plant. This machine is of the revolving locomotive type, mounted on a gantry. While machines similar to this have frequently been used, especially at the plant of the Maryland Steel Company, this machine is novel, in that it is arranged to travel backward and forward on a gantry so as to serve two sides of the pier. It is also of quite a large capacity.

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Changes to be made in copy, or in orders for advertising, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following. If proof is to be submitted, copy must be in our hands not later than the 10th of the month.

Notwithstanding the growing popularity of the Diesel engine for propelling machinery in the maritime world, few have realized the extent to which it has been used in Russia or the large installations which have been made there. Some interesting data in this respect are given in our leading article this month in which there is a résumé of the actual installations which have been made in Russian vessels since 1903. One of the remarkable features of the Russian Diesel-engined craft is the use of horizontal engines driving side paddle wheels through gearing, boats of this type being used as tug boats for river service. That the Diesel engine should be used to a greater extent in Russian vessels than in those of the other continental countries is not surprising, on account of the extensive supply of petroleum in Russia. With a sufficient supply of heavy oil suitable for fuel in a Diesel engine, and available at a moderate cost, the inherent advantages of this type of engine become more important from a commercial point of view. Since the United States produces a higher percentage of the world's supply of petroleum than does Russia, it might be expected that a similar progress in the adoption of heavy-oil engines would take place in America as in Russia. Heretofore the difficulties with American-built heavy-oil engines seem to have been largely of a mechanical nature. That this should be speedily overcome with the growing demand for this type of engine is to be expected, and, in fact, is already apparent.

Economy in the fire-room is sometimes taken for granted by the owners and builders of steam vessels, and if a ship of excellent design is brought into service it is expected that as a matter of course it will show the best over-all economy that could be obtained. As a matter of fact, however, such a vessel, even if it has the minute refinements in the design of the power plant which are necessary for maximum efficiency, may lose the benefits of these refinements by the inefficient work of the engineers in operating the ship. Some of the most common examples of this kind are pointed out very forcibly in one of the letters from practical marine engineers in this issue, wherein are shown the different results which may be obtained by the men in the stokehold. A matter of first importance here is to obtain complete combustion of the fuel, some indication of which is given by the amount of smoke emitted from the funnels. Further than this, the steam generated should be dry or a discouraging amount of the water may disappear from the boilers and go through the engines without doing any work. Such points as these might be called the most elementary part of marine engineering, but still they are fundamental, and should be given first consideration in every case.

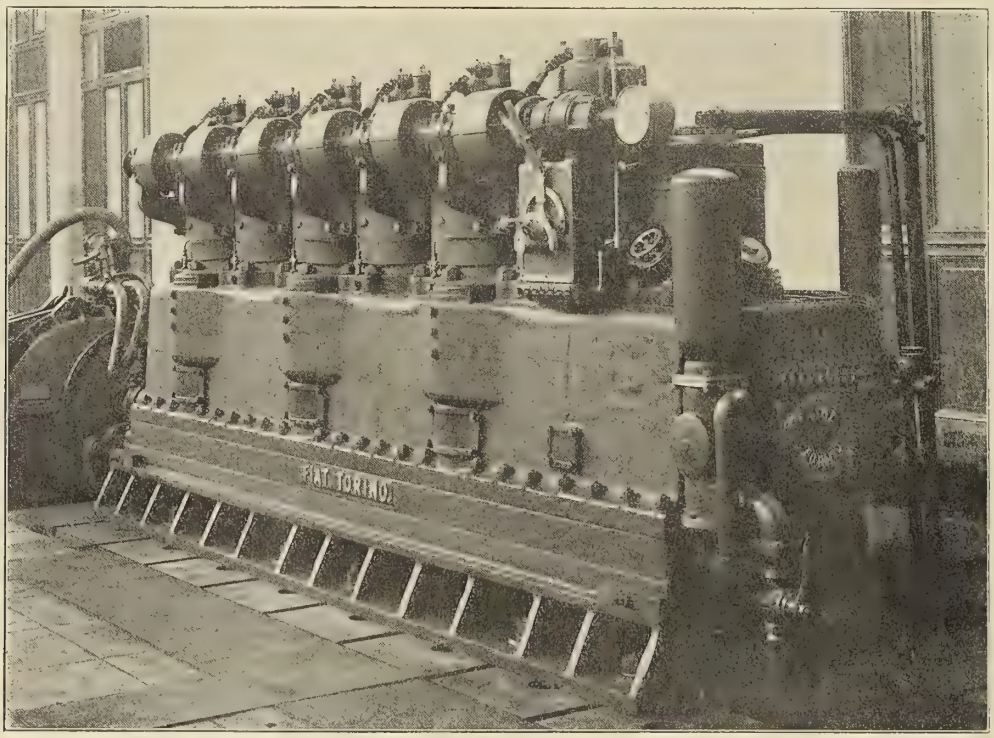
In almost every seaport it is impossible to have direct connection between the various rail and water transportation terminals, and some link is required to provide for the transference of freight from rail to water and vice versa. This condition has resulted in an enormous growth of means for transferring freight from the railroad terminals to the steamship piers by water. This is of particular importance in New York harbor on account of the natural conditions of the harbor which affect the location of both the railroad and steamship terminals. As shown in the article on lighterage, published in this issue, three-quarters of the harbor freight in New York is moved by lighters, and this method of transference is more economical than by drays or transportation on shore; but on account of the great volume of freight movement by lighterage and the lack of mechanical appliances for moving the freight from the deck of the lighter to the hatch of the steamship, a great deal of costly congestion occurs about the slips and piers. Such a condition offers a problem which should be readily solved by scientific investigation and the application of improved appliances for the rapid handling of freight.

Improved Engineering Specialties for the Marine Field

Fiat Heavy Oil Engines

The Fiat Company, Turin, Italy, well known all over the world for their motor cars and gasoline (petrol) engines, have recently taken up the construction of internal-combustion engines, using heavy oil as fuel. The first of these engines built were of the lightweight, quick-running type, specially designed for use on submarines, torpedo boats and on auxiliary boats for large battleships. The success of this type of motor is evident from its use in the Italian navy and by many foreign Admiralties, one well-known instance of which was the installation of the gasolene (petrol) engines on the Swedish submarine *Hvalen,* which accomplished a record voyage from Spezia to Stockholm. After having obtained satisfactory results with the light and high-speed type of heavy oil engines for marine use, and having solved the problems relating to reversing and control, it was a natural step for this company to undertake the construction of higher powered engines, but not with the former limits of weight and space. The Fiat Company is now building heavy oil engines for installations of several thousand horsepower, both on board ship and for stationary work. These engines are all of the two-stroke cycle type, with combustion at constant pressure, and the normal types are built in two series—the Standard industrial type for stationary work and for merchant marine installations, and the high-speed type for naval work or for special applications. The number of revolutions in the first series varies from 150 in the 1,000-horsepower engine up to 3,000 in the 100-horsepower engine. The weight of the engine with accessories is about 88 to 110 pounds per horsepower. The number of revolutions of the high-speed type varies from 450 in the 1,000-horsepower engine to 600 in the 100-horsepower engine. The weight in this case is about 35 to 44 pounds per horsepower. In addition to these normal types the Fiat Company is also building special types designed for exceptional purposes. Just at present the question of using this motive power for the propulsion of large warships is being given much attention by the Fiat Company.

The illustration shows a 600-horsepower engine which runs at 500 revolutions per minute. It is of the normal two-stroke cycle, single-acting type with six cylinders. The lower part of the motor consists of a base plate, which carries the main bearings of the crankshaft. On this plate there is a frame to which are secured the working cylinders, which are cast separately. There are no independent pumps for the supply of the scavenging air necessary for the two-stroke cycle engine. This is furnished by pistons in the main cylinders, there being pistons of double diameters where the upper part, which has the smaller diameter, is the working piston and the lower part acts as an air pump. This arrangement, it is claimed, reduces considerably the length of the engine and enables it to be balanced more easily. The upper part of the frame is used as a reservoir for the scavenging air, which is compressed to from 3 to 6 pounds per square inch, according to the number of revolutions. The air is led through conduits cast in the frame and cylinders to scavenging air valves, which are placed two on each cylinder top, together with the fuel valve and with a compressed air admission valve for starting purposes. The exhaust in the two-stroke engines is accomplished through ports in the wall of the working cylinder, which are uncovered by the piston at the end of the downstroke.



TWO-STROKE CYCLE, SINGLE-ACTING, SIX-CYLINDER, 600-HORSEPOWER FIAT HEAVY OIL ENGINE

At the forward end of the engine, and operated by an extension from the main crankshaft, is fitted a two-stage compressor for supplying highly compressed air for starting purposes and also for the fuel injection. Near the compressor at the end of the engine, and actuated by the main cranckshaft with a speed reduction gear, there is a group of pumps, consisting of a pump for the cooling water for the cylinders and main bearings, and a pump for the lubricating oil. This oil is also used for cooling the tops of the working pistons, as

the cooling obtained by water in types of engines of such a reduced size brings out some serious defects.

The scavenging air valves, the fuel valves and the fuel pump are operated by a horizontal shaft placed in front of the motor, which is itself actuated from the main crankshaft by means of a secondary intermediate vertical shaft and two pairs of worm wheels. On the horizontal cam shaft there is keyed a separate eccentric for each cylinder, which operates the scavenging air valves and the fuel valve. The motion for each cylinder is operated by means of a single angular cam, which receives from the eccentric an oscillating motion, and in one of the end positions opens both of the scavenging air valves and on the other end lifts the fuel valve. In the diagram of the normal distribution on these engines the middle point of the fuel injection phase and the middle point of the scavenging phase are 180 degrees apart from each other, consequently in order to pass from the distribution corresponding to the direction of rotation to the distribution required in the opposite direction, it is sufficient to change the relative positions of the working eccentrics regarding the main crankshaft. This alteration is made by an axial displacement by compressed air of the vertical shaft of the worm-wheel which drives the horizontal distribution shaft. It is claimed that this system of reversing the engine is quick and easy, requiring neither complicated mechanical arrangements nor auxiliary shafts for cams, and, therefore, its operation is steady and reliable. One important advantage as compared to other systems is that the distribution for both the ahead and astern rotations is the same, and therefore the same torsion moment is obtained when the engine is running in either direction. It would also have the advantage that instantly after reversing the engine both the scavenging air and fuel valves are in the proper position.

Starting the engine, as has already been mentioned, is accomplished by highly compressed air admitted to each cylinder through separate valves. There are double profile cams on each cylinder, which are so keyed that they can slide on the horizontal distribution shaft, and their position can be axially displaced on this shaft by moving a small shaft which passes inside the hollow distribution shaft. When the cams are at either of the two end positions the starting valves are opened, and when the cams are in the middle position these valves remain closed.

It has already been stated that in each of the six cylinders there is a piston of a diameter larger than that of the working piston, which acts as a scavenging air pump. The suction and exhaust from these pumps is obtained by means of three piston valves, each valve serving two cylinders, whose cranks are at 180 degrees. These valves are moved by a horizontal shaft connected to the vertical shaft by means of a pair of worm wheels. The change in the relative position of the piston valves for reversing the engine is accomplished at the same time and in the same way as for the distribution.

Control for starting and reversing the engine and governing devices to regulate the speed is effected by means of a lever and handle, which is seen in the illustration in front of the control box placed at the end of the engine, corresponding with the vertical shaft between the last cylinder and the compressor. In the control box are the compressed air valves for the displacements and the fuel pump, with a device to regulate the supply of fuel to the cylinders. The upper lever controls the displacement of the worm wheels on the vertical shafts and the displacements of the cams working the starting valves on the horizontal shaft. The handle regulates the amount of fuel delivered from the fuel pump. With these arrangements control is very simple, and on some official trials made on a motor of this type for the Italian navy the reversing from full speed ahead to full speed astern has been carried out easily in five seconds.

The Diaphone

The diaphone is an instrument for the production of sound, which, it is claimed, is more economical and more powerful than the other types of instruments which have been used for this purpose. For marine signaling up to the present time sound has been produced by instruments of the bell type, steam whistles, sirens and reed instruments. It is a fundamental principle for instruments of this kind that a sound must be pure if the greatest benefit is to be obtained from the power expended, and that it can only be magnified or intensified by being in tune with the mouthpiece, trumpet or resonator, as the directing piece is usually called. The diaphone, as shown in the illustration, consists of a circular chamber, into which air or steam is admitted, and which is provided with circular slits through which the gas is allowed to escape in puffs, and

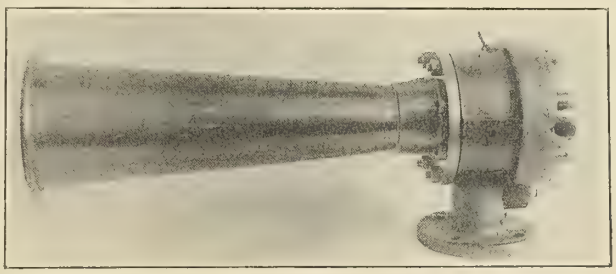


FIG. 1.—ASSEMBLED DIAPHONE

thereby producing sound. A piston, provided with a series of slits corresponding to the slits in the air chamber, moves to and fro very rapidly, opening and closing the slits, permitting the escape of gas at regular intervals. The piston is the only moving part of the instrument and it does not revolve. Its reciprocating motion is obtained by admitting air or steam under pressure from the circular chamber to both sides of the piston, which have different diameters. When pressure is applied to the side of the piston which has the smaller

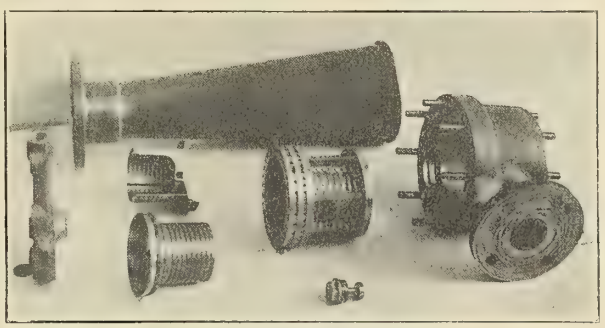


FIG. 2.—SEPARATE PARTS OF DIAPHONE

diameter, the ports are so located that the other side of the piston, which has the larger diameter, is exposed only to atmospheric pressure, therefore the piston is moved in that direction. During its movement ports are opened which admit the high-pressure air or gas to the side of the piston which has a larger diameter, and therefore the pressure on that side of the piston becomes greater than on the smaller side, due to the difference in their areas. This excess pressure moves the piston back in the opposite direction, which opens the exhaust ports. This allows the pressure on the smaller side of the piston to again assert itself and the cycle of operation begins again. The motion of the piston is very rapid, but, due to the location of the ports, sufficient space is left in the chambers to form cushions, which take up the shock from the moving piston and also limit the stroke of the piston. The instrument

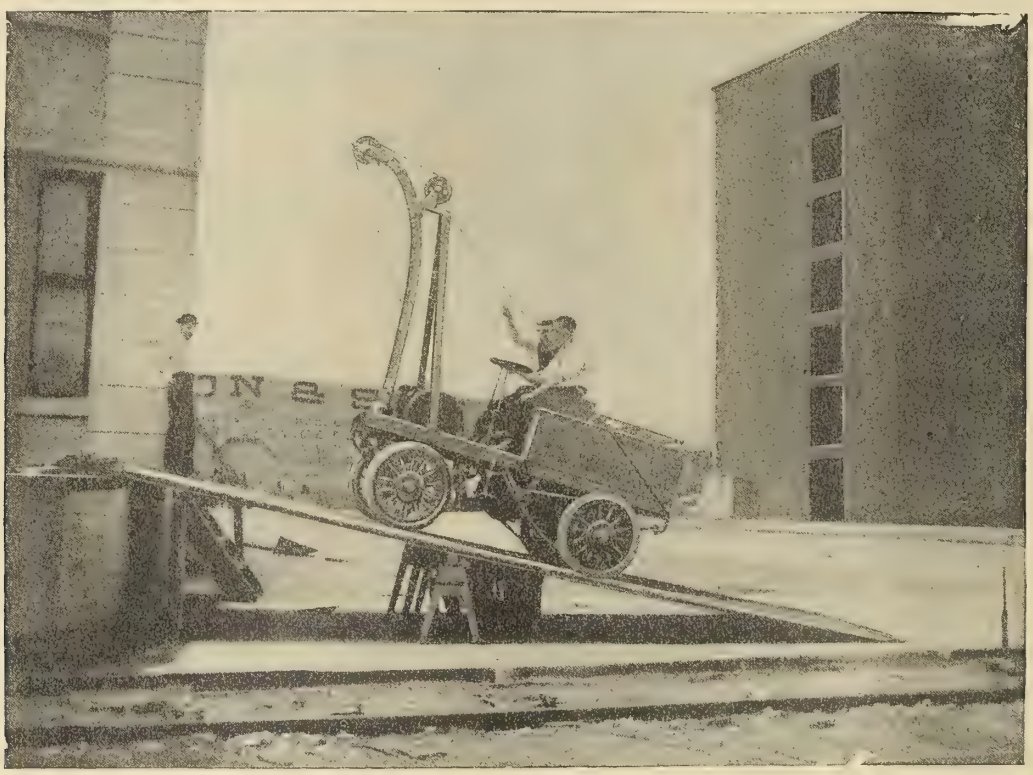
is self-governing; the piston, which is the only moving part, is very light and takes little power for its movement, and is designed as closely as possible to give a certain note at a certain pressure. The cylinder is made of hard gunmetal, and the piston of a much softer metal; therefore the wear occurs on the piston itself, which can be easily renewed at small expense and thus insure durability for the instrument. The manufacturers are the United States Marine Signal Company, New York.

Battery Truck Crane

A device for handling, with expedition and at a low cost, freight and materials, loose or in packages, which have to be lifted and moved through moderate distances, has been urgently needed, not only at the great railway and marine terminals, but also in manufacturing plants and many other places. To meet this demand the General Electric Company, Schenectady, N. Y., is now placing on the market the Battery Truck Crane, an electric vehicle which has a swinging crane mounted on the front end. The crane's hook is raised and lowered by a 1-ton hoist mounted on the front end just back of the crane, the motors driving the hoist and the vehicle being operated from a battery mounted on the rear end. The time, money and step-saving applications of this crane may be classed under three heads—hoisting, hoisting and carrying on the hook, and towing trailers, yet a given movement of material may involve one, two or all of these.

In case where material which may be sub-divided into parcels of 1 ton or less has to be deposited within a 6-foot or 8-foot radius, and this action does not require that the parcel be moved through a vertical distance of over 10 feet, the machine is brought into an advantageous position, the brakes are set, and the vehicle remains stationary as the boom of the crane moves back and forth between the picking up and depositing points. When material, in small or large quantities, has to be moved less than 400 feet, or in small quantities, to any distance, the article is lifted by the hook, conveyed to its destination by the vehicle, and placed on the floor on a rack or a high pile, as desired. For the miscellaneous transfer of large quantities of package freight or other material through a distance over about 400 feet, the best procedure is to use the Battery Truck Crane to tow trailers in trains of about four.

The Battery Truck Crane is designed for a high draw-bar pull, its maximum being a pull of 2,000 pounds, and equal to that of a 5-ton locomotive on rails and sufficient to spot a car, pull wagons or automobiles out of mud holes, and to readily handle loads of from 5 to 8 tons on trailers.



BATTERY TRUCK CRANE OPERATING UP AN INCLINE

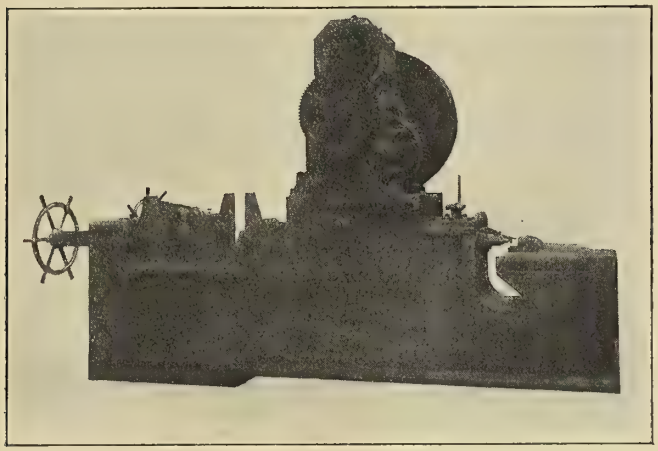
A Condenser Tube for Marine Work

In marine work there has always been a need for a condenser tube that has a reasonably high coefficient of heat transfer and could successfully withstand the corrosive action of the salt water used for cooling purposes. Therefore the tests made on a Monel metal condenser tube by Mr. George A. Orrok, and presented in his paper on the "Transmission of Heat in Surface Condensation," read before the American Society of Mechanical Engineers, are of considerable interest, as the Monel metal tube showed a coefficient of heat transfer of .75 in comparison to copper's 1.00; but it is claimed that the great advantage of the Monel metal tube is that it is less corrodible than bronze, as strong as steel, and the finish is similar to pure nickel. Brass condenser tubes for protection are often tinned on the inside or both sides. Not only does this lower the coefficient of heat transfer, but, also, bimetallic tubes are apt to split. The Monel metal tube is made in one piece, thus eliminating this drawback. It is a fact that corrosion, oxidation, vulcanizing, pitting, etc., reduce remarkably the heat transferred, therefore a tube of Monel metal will stand up to its work and will not have to be often replaced, as is the case with tubes that cannot withstand the corrosive effect of salt water.

Monel metal tubes consist of 67 percent nickel, 27 percent copper, and 6 percent of other materials, so that the tubes are strong but ductile.

Combined Horizontal Punch, Beam Bender and Bulb Shearing Machine

The machine, which is designed for beam-shed work in a shipyard, consists of a twin horizontal punch at one end and a combined beam bending and bulb shearing machine at the opposite end. The punching apparatus consists of a strong slide working in accurately planed guides, carrying two punches side by side with special stop motion, so arranged that either one punch can be used independently but not both together, and also arranged so that in the mid position neither punch is operative. The capacity is to punch one hole 1¼ inches diameter through mild steel plate 1 inch thick. The depth of the gap is 18 inches. The dies are carried upon a readily detachable cast steel die head of special design, to enable holes to be punched in the root or flange of beams, etc.



A USEFUL SHIPYARD TOOL

A spare die head is also provided for punching holes in beams, etc., less than 6 inches deep. Efficient means are provided for the punching burrs to get clear away behind the machine. An adjustable roller is provided on each side of the gap to rest the work upon while passing through the machine.

The method of using this apparatus is to fix two punches of different diameters, say ⅝ inch diameter and 1¼ inches diameter. The ⅝-inch punch is used for rivet holes, which are punched consecutively until the point is reached where the larger hole is required, when the 1¼-inch punch is immediately available, after which ⅝-inch diameter holes are again punched consecutively until another large hole is reached. This avoids handling the bar or changing the punch.

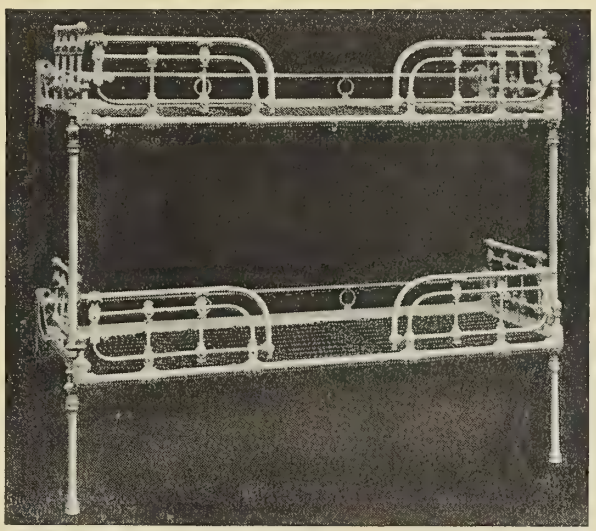
At the opposite end the bulb shearing apparatus consists of a strong horizontal slide of special design in cast steel, fitted with a shear blade capable of taking off the bulb from a beam or angle for a length of 6 inches at one cut, level with the web. It will also shear out a piece of the leg 6 inches wide at one cut. The slide is provided with independent stop motion by a convenient hand lever, and a spare slide is also provided for the smaller size of bulb angles, channels, Z-bars, etc. A convenient and efficient clamping device is provided to hold the bulb angle or beam in position while the bulb is being sheared off.

The beam-bending device is also at this end of the machine, and consists of one central cast steel hammer, which reciprocates continually with a stroke of about 2 inches, and two bending hammers, each sliding in planed guides and carried on the ends of strong steel screws, each provided with a large hand-wheel. These two hammers can be set at 4-foot 6-inch centers for beams, joists, etc., up to 15 inches deep, or at 2 foot 10-inch centers for lighter work. Adjustable rollers are provided at each side of the machine for passing the work through.

The body of the machine is a massive box-section casting, accurately machined where necessary and carrying the various slides in guides of ample area. The slides are actuated by a strong toggle from the main eccentric shaft. The main eccentric shaft is of Siemens forged steel running in long bearings, accurately machined, in the body of the machine and driven through powerful double-purchase cast steel gearing and heavy turned flywheel. The flywheel shaft is driven by machine-cut reducing gear by a continuous-running electric motor mounted on planed seatings on top of the machine. The flywheel shaft and second-motion shaft are carried in capped gunmetal-lined bearings in two strong gearing brackets, rigidly attached to the main body, with tongue and groove joints and pin-fitted bolts and rigidly stayed together. The whole machine is of massive rigid design, capable of doing the maximum work continuously at a speed of thirty strokes per minute at both ends. It is manufactured by Scriven & Company, of Leeds.

Ships' Berths

Whitfields Bedsteads, Ltd., Watery Lane, Bordesley, Birmingham, has been engaged for a good many years in the manufacture of high-grade ships' berths of all kinds, swinging,

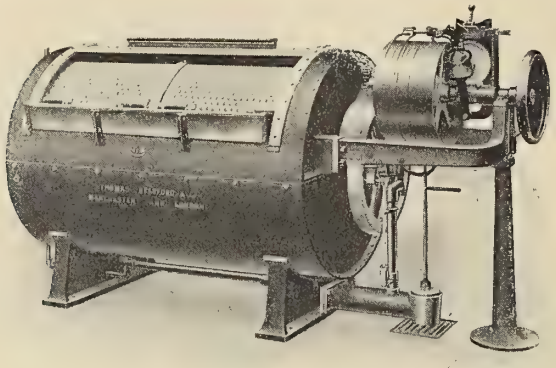


hanging, fixed, folding and steerage, with chain mattresses, woven wire mattresses or with galvanized lath bottoms. The illustration shows a folding-up berth, which is built with a special spring mesh, which is divided down the center from end to end, making it, it is claimed, impossible for the mattress to sag.

Bradford's Patent "Sugar" Washing, Boiling and Rinsing Machine

Thomas Bradford & Company, Manchester, have on the market a washing, boiling and rinsing machine in which the washing compartment is fixed eccentrically on its bearings and rises and falls with each revolution, thus forcing all of the washing suds or rinsing water through the clothes at each revolution. This feature, it is claimed, results in quicker and better work, with better economy of soap and water. Experiments have shown that the wear and tear and consequent depreciation of linen result from boiling and rinsing clothes at

the high speed necessary for the washing process, and so the machine illustrated has been developed, which, by a simple movement of a lever, reduces the speed during the rinsing



process. These machines have proved particularly useful in laundry installations on board large passenger steamships.

Arc Lights on the Ambrose Channel Lightship

Until recently it was considered impossible to use arc lamps on lightships and lighthouses, although their intrinsic brilliancy and color were considered very desirable for this work. One of the chief objections was that the weather conditions were too extreme. As a result of recent experiments, however, the lightship which marks the eastern entrance to the Ambrose Channel in New York harbor, and is officially known as the Ambrose Channel Lightship No. 87, has been equipped with this type of lights and has proved very successful.

The power equipment consists of two 7½-kilowatt marine type General Electric steam engine generator sets complete,

with panel boards and all necessary switches for controlling the circuit on the ship. There are two single masts, each carrying three lanterns of standard lighthouse design, which are hung in gimbals in order that the plane of illumination may be maintained horizontal regardless of a seaway. A vertical type carbon-flame arc lamp, operating at 110 volts, 6½ amperes, and giving a horizontal maximum candle-power of approximately 4,000, is placed in each lantern. The arc is placed at the focus of the lens, which is so located that the light emitted from the arc through a space of 60 degrees is concentrated and passes from the lens with a divergence of about 8 degrees, the result being that a powerful zone of light is projected in a horizontal direction. The three lenses are spaced at equal distances about the masts, and are so arranged that at least two of them are visible from any point of view. At a distance of approximately 2 miles the two lights merge into one apparent light source. In normal position the lamps are 55 feet above the waterline, and are visible for a radius of 8½ miles at sea level, 15 miles at an altitude of 15 feet, or 23 miles at 50 feet above sea level. The lights are first "picked up" by incoming vessels soon after passing Fire Island.

This equipment has now been in continuous service for more than a year, and such success has been achieved that steps are now being taken to equip other lightships in a similar manner, with the promise that the carbon-flame arc lamp will prove to be the most efficient illuminant for this most trying of all services.

Technical Publications

Warships and Their Story. By R. A. Fletcher. Size, 6 by 9 inches. Pages, 348. Illustrations, 80 full plates. Cassell & Company, Ltd., London. Price 21/–.

During the past twelve months quite a number of handsome illustrated volumes dealing with steam, sailing and warships have emanated from the press of British publishers. The volume before us is well up to the standard of the other popular volumes. The author recounts in non-technical and attractive style the development of the world's warships and follows the lines on which they have progressed. The subject is, of course, a tremendous one, and Mr. Fletcher seems to have been overwhelmed with material and acknowledges his indebtedness to a legion of authorities. No less than 80 full-page plates are included, and these are particularly well chosen and admirably executed. The colored frontispiece shows an impression of "A coming type of battleship" (an interpretation of the funnelless ship with internal-combustion engines, as suggested by Mr. J. McKenzie). A very carefully compiled index, which includes the names of all the ships mentioned, completes this interesting and attractive work.

Mechanical Inventions of To-day. By Thos. W. Corbin. Size, 7¾ by 5¼ inches. Pages, 323. Illustrations, 112. Seeley, Service & Company, Ltd., London. Price, 5/ net.

The series of popularly illustrated books on science of to-day has been added to by the above volume. The author issued a previous volume in the same series on engineering, which was exceptionally well received. We can foretell an equally good welcome for the new volume, which is most attractively got up. It gives in twenty-four chapters of non-technical language full and interesting descriptions of all the principal modern mechanical inventions. Some 112 illustrations and drawings are included; in many cases these are not working drawings but have been modified to enble the reader to understand the subject illustrated with a minimum of trouble.

Marine Steam Turbines. By Dr. G. Bauer and O. Lasche. Translated by M. G. S. Swallow. Size, 6 by 9¼ inches. Pages, 214. Illustrations, 103. London, 1911: Crosby, Lockwood & Son. Price, 10/6 net.

Dr. Bauer's work on the "Design and Construction of Marine Engines and Boilers" is well known to those interested in marine engineering, because it has long been recognized as a very complete and reliable treatise on the subject. The recent advance of the steam turbine for marine propulsion has been the occasion for the publication of a supplement to the volume on marine engines and boilers to deal in a like manner with the steam turbine. The need of such a supplement has been well filled by the book under review. A brief description of the theory of steam turbines is given to enable the reader to understand the calculations for steam turbines. Following the general remarks on the design of a

turbine installation and the calculation of steam turbines, the question of the design of a few of the common types of turbines is taken up, including the accessories. Shafting and propellers suitable for turbine installations and condensing plants are also considered. A part of the work which is of timely interest is that regarding the arrangement of different types of turbine installations on various kinds of vessels which is the result of actual practice up to date.

Communication

Naval Architects' Meeting

EDITOR INTERNATIONAL MARINE ENGINEERING:

To those who were fortunate to have been present at the last meeting of the Naval Architects and Marine Engineers' Society it would be a truism to say that the meeting was one of the most successful, if not the most successful one ever held.

The readers of INTERNATIONAL MARINE ENGINEERING will have seen in its pages some of the papers which were presented by the members of the society, and they can judge thereby to a certain extent the value of what was presented and discussed.

But one of the most important features was the fact of having Sir William Henry White at all the meetings, where his delightful personality interjected into the discussions something that cannot be conveyed by merely speaking of him. Let us drop for a moment the title of Sir William and we will find one of the most charming gentlemen, one of the most interesting talkers, and one of the most profound thinkers that can be met in the entire world. Certainly his title is well deserved, but were it even higher than it is it would not add one iota to his splendid character. He has every right to the title of a true man, and higher than this I do not believe a title exists. Everyone who met him is a better man and better informed by that meeting, and no better selection, in my opinion, could be found for the Fritz medal than he, and his beautiful speech of acceptance will be long remembered by all who heard it.

Certainly some of the papers suggested food for thought which cannot be digested in a moment. Mr. Harding adopted a most admirable plan of presenting a paper by means of lantern slides expatiating on the subject of the handling of goods at terminals in a way which added greatly to his paper It is a pity that a little more time cannot be given to subjects of such great importance, and it is a question in my mind whether it would not be wise to have a three days' meeting instead of two, as now. Mr. Harding fairly galloped through his interesting subject, which was a disadvantage.

Deputy Commissioner Barney's paper on the harbor of New York was something that brought up a matter of the very greatest importance; that is, the terminal facilities in New York City. It is absolutely beyond my own comprehension why it is proposed to make terminals on the Long Island side of the harbor. The very fact that it is an island is against the idea, and certainly the Jersey shore is the proper place for large terminals, as to the westward lies the main part of our country, and the one object of terminal facilities; that is, rapid handling of material after it reaches port, is far better obtained when directly shipped from the Jersey shore west than from any part of Long Island.

The whole question of handling freight more economically must be not decided *en bloc,* but must be settled by each particular locality and, of course, by the freight handled. Bulk cargoes, as pointed out by one speaker, can be handled on the Great Lakes in incredibly short time; but what we are concerned with in New York is the more economical handling of mixed freight.

Of course the turbine and internal-combustion engine question was to the fore, and it was regrettable that there was a little show of feeling in some of the discussions. It should be born in mind by every member of the society that all have a right to differ from the speaker, or concerning the paper, but that difference should be a mental and not a personal one.

Besides the papers read there was much discussion outside of the meeting between the members, and it was pleasing to note a very hopeful mental condition concerning American shipping. True, it was suggested by one member that it would be a pretty good idea to tear up some of our treaties, but the suggestion that the clauses in those treaties which work to a large extent against our merchant marine were interjected by the wise foreign nations who formulated them is hardly admissible, to my mind, as I believe they could be traced to their source nearer home; but it certainly is time for the people of the United States, who have appropriated to this the name of Americans, to find out whether the mere fact of commercial interests must stand in the way of a general betterment to the public. Mr. Nixon's suggestion as to special treaties with Mexico and countries to the south is certainly wise.

In the internal-combustion engine matter I am sorry that some of the statements were not questioned. One was that the up-keep of this style of prime mover is much less than that of the steam engine and boiler. I do not think that this can be shown to be a fact. One well-known vessel that made this port not long ago, heralded as the coming type of merchant-carrying vessel and fitted with internal-combustion engines, limped in, in pretty bad shape as to her motive power. Now to run an engine economically for an hour and then have it stop for several hours in order to make repairs, does not give an economical prime mover, and it is rather strange that in foreign countries the internal-combustion engine seems to be a far more satisfactory prime mover than it is in America. Not long ago I was asked where a well-known type of foreign internal-combustion engine could be built in the United States. These engines were large, none of them smaller than 400 horsepower. The gentleman who interviewed me stated that patterns would be furnished, and drawings and all material would be specified, and under no circumstances would any change whatever be permitted. He flatly told me that where he was operating, which was on this side of the Atlantic, he could not sell American-built gas engines, and the foreign-built engine had the market; but he thought he could save freight and money by having the engines duplicated in the United States, and I was somewhat chagrined to have him also say that the workmanship on the American internal-combustion engines was nowhere nearly as good as what was found in the foreign product, either English or Continental. My experience has not shown me that we are behind-hand in workmanship, but it has shown me the desire on the part of American manufacturers to alter things merely because American practice was somewhat different, and I know in several cases this change has been fatal to the successful operation of the mechanical contrivance.

The election of Mr. Cox to the secretary-treasurership was most satisfactory, but everyone regretted the necessary resignation of Captain Baxter. Mr. Cox's selection was admirable, not only in the man himself, but in the fact that it bridged over a little feeling that this position must be always held by a naval man. Mr. Cox having been a naval man and is now in commercial life breaks up this idea.

I would suggest that members of the society think carefully over the matter of three-day sessions, and as far as I am concerned I would strongly advocate it, as the delightful intercourse with members is now too short.

New London, Conn.

W. D. FORBES.

Selected Marine Patents

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Loan & Trust Building, Washington, D. C.

1,001,668. SHIP'S-BELL CLOCK. WALTER K. MENNS, OF MALDEN, MASS., ASSIGNOR TO CHELSEA CLOCK COMPANY, OF BOSTON, MASS., A CORPORATION OF MASSACHUSETTS.

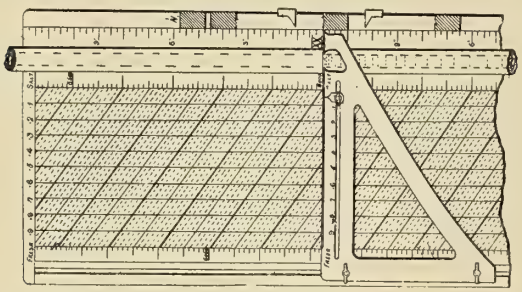
Claim 2.—The combination with a ship's bell clock having mechanism to actuate a single hammer at regular intervals double strokes with intervening rests, combined with means at alternate intervals to render one stroke of said hammer ineffectual, of a sounding device, and means operatively related to said actuating mechanism for controlling the operation of said sounding device. Ten claims.

1,001,601. BOAT. PAUL I. ANDREWS, OF KENNEBUNK, MAINE.

Claim 1.—A boat having a hull made from an integral piece of molded material with smooth sides whose upper edge is formed with an L-shaped off-set integral therewith, the base leg of said off-set extending horizontally inward and thence vertically upward. Four claims.

1,002,857. APPARATUS FOR INDICATING THE WEIGHT OF A VESSEL'S CARGO. DONALD MACKAY, OF ALLOA, SCOTLAND.

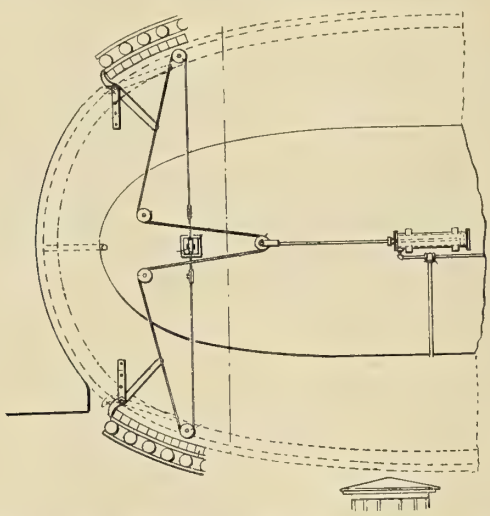
Claim 1.—In apparatus for indicating the weight of cargo in a ship, in combination, a water gage consisting of a tube open to the atmosphere and communicating with the water line below the "light" water



line of the ship, a scale of deadweight positioned in juxtaposition to said tube, said scale being provided with curves corresponding to the range of densities from fresh water to salt water and an indicator operatively associated with said scale and said tube adapted to indicate the deadweight corresponding to the density of the water and the height of the water in the tube. Two claims.

1,002,987. FERRY-MOORING DEVICE. GEORGE WALTER HARNEY, OF PORTSMOUTH, VA.

Claim 2.—A ferry boat provided with mooring hooks, a motor mechanism connected with the hooks for throwing the same outwardly to moor-



ing position, a pilot's controller for the motor, and means co-operating with the motor mechanism to retract the mooring hooks. Eleven claims.

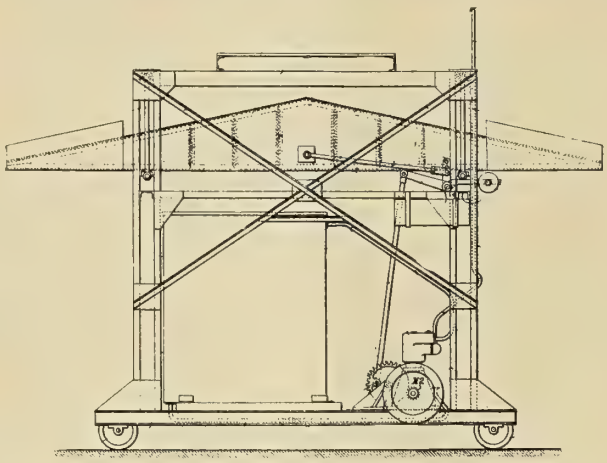
1,002,903. SOUND-RECEIVING DEVICE. SIDNEY M. DAVISON, OF CAMBRIDGE, MASS.

Claim 2.—In an apparatus for signaling under water, the combination of an inclosure secured to the skin of a vessel from which the air is adapted to be withdrawn; a casing contained within said inclosure and free from its walls adapted to contain a fluid; and a sound-receiving device within said casing submerged in said fluid. Four claims.

British patents compiled by G. E. Redfern & Company, chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 21 Southampton Building, W. C., London.

3,480. RIDDLE TO ENABLE ORE TO BE DISCHARGED FROM SHIPS DIRECT TO RAILWAY WAGONS IN A RIDDLED CONDITION. J. DONALDSON, GLASGOW.

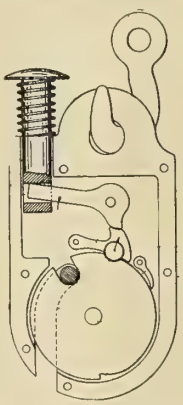
Certain ironmasters require ore delivered to them riddled to pass through a given mesh. Each tub of ore is taken from the ship to the quay, riddled and finally loaded into the wagons. In saving labor, time and expense by means of this invention, a riddle is provided of a con-



struction that will receive the ore without damage to itself, and made so that whilst it extends over the wagons, these may be readily moved independently of the riddle. A gantry runs on wheels, and beneath it trucks can pass. Above, a riddle is suspended by links, and is of a length and breadth such that it extends entirely over one truck, and its ends extend partly over the trucks on each side. The riddle is oscillated and a grating is secured above its center, and upon this the load first breaks its fall.

14,692. DISENGAGING GEAR FOR BOATS. J. W. WALKER, BRADFORD.

In order to ensure instantaneous and automatic release, this invention provides for obviating the friction common to these machines. The boat is secured to the tackle by a disc which holds the suspension ring or the



like in a notch. The disc is locked to its frame by a bowl carried by a lever and engaging a notch in the disc. A second lever locks the first until its longer arm is depressed by means of a push, a rope or the like; then the weight of the boat rotates the disc and so allows the suspension ring to leave the slot in the frame, the disc rotating no further, because the pawl engages notch. The boat is again locked in place by simply reinserting its ring into the slot, and so rotating the disc backward.

6,974. TELESCOPING TUBULAR MASTS. FONTANAMASTE-UND TRAGER GESELLSCHAFT, m. b. H., BERLIN.

The telescopic parts are in a casing, and are extended by a screw which is longer than each tube. Each tube has at its lower end a nut, and all of these, with the exception of the innermost, are out of engagement with the screw when the mast is retracted. On turning the screw, first the innermost tube is raised until it strikes with a projection against the top of the tube surrounding it. It then carries this tube with it so that the base of it engages the screw in turn and finally leaves screw, having been bolted to the tube by an automatic locking device.

28,639. HOLDERS FOR HOLDING OPEN CABIN DOORS, ETC. W. MULLAN, BELFAST.

A bar pivoted to the door frame engages an eye fixed to the door. The eye is open at the top, but does not permit the bar to pass upward until the eye has passed over it lengthwise to near the closed position. The bar is gapped at a point and can thus be lifted clear within the cabin. There is a cylinder containing a spring bolt for preventing rattle and for holding the bar vertically when not in use. A gap in the outer end of the bar allows it to engage the door against movement, and the eye and peg serve a similar purpose.